CLIPPEDIMAGE= JP407169635A

PAT-NO: JP407169635A

DOCUMENT-IDENTIFIER: JP 07169635 A

TITLE: ELECTRONIC COMPONENT AND MANUFACTURE THEREOF

PUBN-DATE: July 4, 1995

INVENTOR-INFORMATION:
NAME
HAYAMA, MASAAKI
MORI, NOBORU
NAKAO, KEIICHI

ASSIGNEE-INFORMATION:
NAME COUNTRY
MATSUSHITA ELECTRIC IND CO LTD N/A

APPL-NO: JP06226584

APPL-DATE: September 21, 1994

INT-CL (IPC): H01F041/04;H01F017/00

ABSTRACT:

PURPOSE: To provide a method for manufacturing an electronic component by which fine patterns can be formed precisely and via hole electrodes can be formed simultaneously and thereby a conductor pattern of a high-performance lamination structure can be formed easily in the intaglio printing wherein a conductor pattern is formed on an insulating substrate by transferring and to provide an electronic component which is manufactured by such a method.

CONSTITUTION: A pattern is so formed on the surface of flexible resin that it may have recesses at any locations which are formed deeper than any other sections. Then, a peel-off layer 23 is formed on the

surface of the pattern to
form an intaglio 20. Ag paste 24 is filled into the
intaglio 20 and is dried.
After laminating the intaglio 20 on an insulating substrate
2 whose surface is
coated with a thermal plastic resin layer 28 by using
thermal rollers 26, 27,
the intaglio 20 and the insulating substrate 2 are
separated and then a pattern
of the Ag paste is transferred and burned to form a
conductor pattern.

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（A）　(11)特許出願公開番号

特開平7－169635

(43)公開日　平成７年(1995)７月４日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｈ０１Ｆ　41/04		Ｂ		
17/00		Ｂ	8123－5Ｅ	

審査請求　未請求　請求項の数22　ＯＬ　（全 18 頁）

(21)出願番号　特願平6－226584

(22)出願日　平成６年(1994)９月21日

(31)優先権主張番号　特願平5－234522

(32)優先日　平５(1993)９月21日

(33)優先権主張国　日本（ＪＰ）

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地

(72)発明者　葉山　雅昭
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　毛利　昇
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　中尾　恵一
大阪府門真市大字門真1006番地　松下電器産業株式会社内

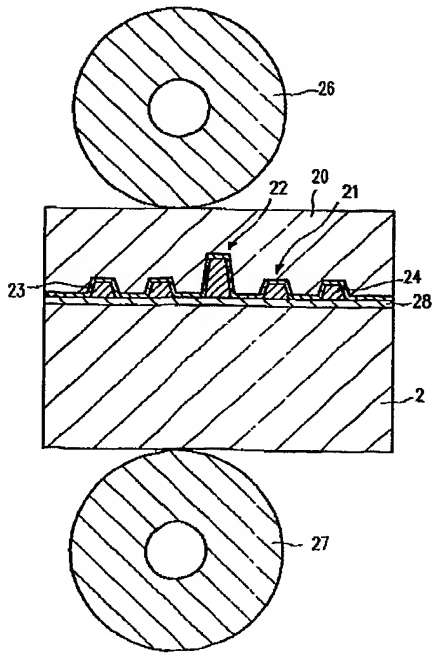
(74)代理人　弁理士　小鍜治　明　（外２名）

(54)【発明の名称】　電子部品およびその製造方法

(57)【要約】

【目的】　転写によって導体パターンを絶縁基板上に形成する凹版印刷において、高精度で微細なパターンを形成でき、かつ、ビアホール電極も同時に形成して導体パターンの高性能な積層構造を容易に製造できる電子部品の製造方法、及びそのような方法によって製造された電子部品を提供することを目的とする。

【構成】　可とう性樹脂の表面にレーザ加工によって任意の位置の溝が他の箇所より深いパターンを形成し、その表面に剥離層２３を形成して凹版２０を形成する。凹版２０にＡｇペースト２４を充填して、乾燥させる。熱可塑性の樹脂層２８を表面に設けた絶縁基板２上に熱ローラ２６，２７を利用して凹版２０をラミネートした後に、凹版２０と絶縁基板２とを剥離してＡｇペーストのパターンを転写して、焼成によって導体パターンを形成する。



1

【特許請求の範囲】

【請求項１】　基板上に第１導体パターンを凹版印刷によって形成する電子部品の製造方法において、

（ａ）可とう性樹脂の表面に、溝を前記第１導体パターンに対応するパターンで形成して凹版を製造する工程と、

（ｂ）前記凹版の表面に、前記基板と前記凹版との剥離を容易にする剥離層を設ける工程と、

（ｃ）前記溝に導電性ペーストを充填する工程と、

（ｄ）前記導電性ペーストを乾燥する工程と、

（ｅ）前記導電性ペーストを乾燥する工程（ｄ）で乾燥された前記導電性ペーストを再軟化させて乾燥による体積減少分を補うために追加の導電ペーストを再充填する工程と再充填後の前記導電ペーストを再乾燥する工程とを所定の回数繰り返す工程と、

（ｆ）前記凹版と前記基板とを所定の範囲の熱及び所定の範囲の圧力を加えることによってラミネートして貼り合わせる工程と、

（ｇ）前記凹版を前記基板から剥離して、前記導電ペーストのパターンを前記基板上に転写する工程と、

（ｈ）転写された前記導電ペーストのパターンを焼成して、前記第１導体パターンを形成する工程からなる電子部品の製造方法。

【請求項２】　可とう性樹脂の表面に、溝を前記第１導体パターンに対応するパターンで形成して凹版を製造する工程（ａ）は、前記凹版に形成される前記溝の一部を他の箇所より深く形成して、それによって、前記第１導体パターンの一部に高さの差を設ける請求項１記載の電子部品の製造方法。

【請求項３】　基板上に第１導体パターンを凹版印刷によって形成する電子部品の製造方法において、

（ａ）可とう性樹脂の表面に、溝を前記第１導体パターンに対応するパターンで形成して凹版を製造する工程と、

（ｂ）前記凹版の表面に、前記基板と前記凹版との剥離を容易にする剥離層を設ける工程と、

（ｃ）前記溝に導電性ペーストを充填する工程と、

（ｄ）前記導電性ペーストを乾燥する工程と、

（ｅ）前記導電性ペーストを乾燥する工程（ｄ）で乾燥された前記導電性ペーストを再軟化させて乾燥による体積減少分を補うために追加の導電ペーストを再充填する工程と再充填後の前記導電ペーストを再乾燥する工程とを所定の回数繰り返す工程と、

（ｆ）前記凹版と前記基板とを所定の範囲の熱及び所定の範囲の圧力を加えることによってラミネートして貼り合わせる工程と、

（ｇ）前記凹版を前記基板から剥離して、前記導電ペーストのパターンを前記基板上に転写する工程と、

（ｈ）転写された前記導電ペーストのパターンを焼成して、前記第１導体パターンを形成する工程と、

2

（ｉ）前記第１導体パターンの少なくとも一部を覆う絶縁層を形成する工程と、

（ｊ）前記絶縁層の表面に第２導体パターンを形成する工程と、

（ｋ）前記第１導体パターンの前記絶縁層によって覆われていない部分に、前記第１導体パターンと前記第２導体パターンとを電気的に接続する電極を設ける工程と、からなる請求項２記載の電子部品の製造方法。

【請求項４】　（ｌ）第１導体パターンの少なくとも一部を覆う絶縁層を形成する工程と、

（ｍ）前記絶縁層の表面に第２導体パターンを形成する工程と、をさらに包含しており、前記第１導体パターンのうちで高さが高く形成されている箇所を電極として使用して、前記第１導体パターンと前記第２導体パターンとを電気的に接続する請求項２記載の電子部品の製造方法。

【請求項５】　絶縁層の表面に平坦部を設けるべき箇所に対応する前記第１導体パターンの部分を低く形成する請求項４記載の電子部品の製造方法。

【請求項６】　絶縁層の表面の前記平坦部にＩＣチップをフェースダウン実装する工程をさらに包含する請求項５記載の電子部品の製造方法。

【請求項７】　絶縁層が磁性材料によって形成されている請求項３から６のいずれかに記載の電子部品の製造方法。

【請求項８】　可とう性樹脂の表面に、溝を前記第１導体パターンに対応するパターンで形成して凹版を製造する工程（ａ）は、紫外領域の発振周波数を有するレーザを用いて前記溝を形成する請求項１から７のいずれかに記載の電子部品の製造方法。

【請求項９】　レーザがエキシマレーザである請求項８記載の電子部品の製造方法。

【請求項１０】　剥離層が、フッ化炭素系の単分子膜である請求項１から９のいずれかに記載の電子部品の製造方法。

【請求項１１】　導電性ペーストに可塑剤が添加されていて可とう性を有している請求項１から１０のいずれかに記載の電子部品の製造方法。

【請求項１２】　凹版に形成される前記溝が、側面にテーパ角を有する断面形状を有している請求項１から１１のいずれかに記載の電子部品の製造方法。

【請求項１３】　基板が、絶縁基板と、前記絶縁基板の少なくとも一方の表面に形成された厚さ２０μｍ以下の樹脂層とを備え、前記樹脂層は熱硬化性樹脂または熱可塑性樹脂である請求項１から１２のいずれかに記載の電子部品の製造方法。

【請求項１４】　絶縁基板が誘電材料から形成されている請求項１３記載の電子部品の製造方法。

【請求項１５】　絶縁基板が磁性材料から形成されている請求項１３記載の電子部品の製造方法。

3

【請求項１６】　基板がグリーンシートから形成されている請求項１から１２のいずれかに記載の電子部品の製造方法。

【請求項１７】　基板と、
可とう性樹脂のレーザ加工によって形成された凹版を使用した凹版印刷によって前記基板上に転写された第１導体パターンと、を備える電子部品。

【請求項１８】　基板と、
可とう性樹脂のレーザ加工によって形成された凹版を使用した凹版印刷によって前記基板上に転写された第１導体パターンと前記第１導体パターンの少なくとも一部を覆う絶縁層と、
前記絶縁層の表面に形成された第２導体パターンと、
前記第１導体パターンの前記絶縁層によって覆われていない箇所に設けられて、前記第１導体パターンと前記第２導体パターンとを電気的に接続する電極とからなる電子部品。

【請求項１９】　第１導体パターンの一部に高さの差が設けられている請求項１７記載の電子部品。

【請求項２０】　第１導体パターンの少なくとも一部を覆う絶縁層と、
前記絶縁層の表面に形成された第２導体パターンと、をさらに備えており、前記第１導体パターンのうちで高さが高く形成されている箇所を電極として使用して、前記第１導体パターンと前記第２導体パターンとを電気的に接続する請求項１９記載の電子部品。

【請求項２１】　絶縁層の表面に平坦部を設けるべき箇所に対応する前記第１導体パターンの部分が低く形成されている請求項２０記載の電子部品の製造方法。

【請求項２２】　絶縁層の表面の前記平坦部にフェースダウン実装されたＩＣチップをさらに備える請求項２１記載の電子部品。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、各種電子機器に用いる電子部品およびその製造方法に関し、特に、凹版印刷によって製造される電子部品およびその製造方法に関する。

【０００２】

【従来の技術】近年、電子機器の小型化が進んでおり、それに伴って電子機器内で使用される電子部品の小型化が進んでいる。このような状況の下で、電子部品の導体パターンに対しても、パターンを構成する導体ライン（以下、単にラインと称する）の微細化、ライン抵抗を下げることを目的とした導体パターンを構成する導電膜の厚さの増加、さらに小型化のための積層構造化が要求されている。

【０００３】従来の電子部品の導体パターンは、スクリーン印刷や凹版印刷などの印刷法で銀ペーストや銅ペーストなどの導電性ペーストのパターンを被形成物（基板）上に印刷して、これを焼成して形成されてきた。例えば、凹版印刷法の応用としては、特開平４－２４０７９２号公報に開示されているように、形成すべき導体パターンに対応した凹版内に導電ペースト（有機金属インク）を充填し、その導電ペーストを乾燥・硬化させてから、被形成物である基板上に硬化性樹脂を介してそのパターンを転写することによって、所望の導体パターンを形成する印刷方法が知られている。

【０００４】さらに、ハイブリッドＩＣ回路、サーマルヘッド、あるいは透明電極などでは、導体パターンにおける各ラインの幅、及びラインの間隔が微細になることから、薄膜形成とエッチングとを利用した方法が用いられていることがある。この方法では、被形成物である基板上に、蒸着またはスパッタリングで金、アルミニウム、ＩＴＯなどの導電材料の薄膜を形成して、感光性樹脂を用いたフォトリソグラフィー技術によって所望の導体パターンに対応したマスクパターンを形成し、次にエッチング液及びマスクパターンを用いたエッチングを行って導電材料の薄膜をエッチングし、最後に感光性樹脂を除去して導体パターンを形成する。

【０００５】

【発明が解決しようとする課題】しかしながら、上述の従来の方法は、以下のような問題点を有している。

【０００６】従来のスクリーン印刷は比較的安価な設備で実行することができ、また必要な工程数は少ない。しかし、形成すべき導体パターンのラインの幅が７０μｍ以下であるような微細導体パターンを、スクリーン印刷で形成することは困難である。また、ラインピッチを１５０μｍ以下に低減することは困難である。また、スクリーン印刷では導体パターンは一様に印刷されるので、設計上の要求に合わせてパターン中に高低差（ラインの高さの差）を設けることはできない。

【０００７】従来の凹版印刷では、ラインの幅が５０μｍ程度でラインピッチ１００μｍ程度の微細導体パターンを形成することが可能であるが、５μｍ以上の厚さを有する導体膜を形成することが困難であって、導体抵抗の低減に限界がある。

【０００８】一方、電子部品の所望の高密度化を達成するためには、各層の導体パターンの微細化だけでは十分ではないことがあり、したがって積層構造の形成が必要になる。そのような積層構造では、下層導体パターン、絶縁層、上層導体パターンというサンドイッチ構造が幾重も重なって形成される。この場合、上下層の導体パターンを接続するビアホールを形成する必要があるが、導体パターンの微細化にともなってそれらビアホールの微細化も必要になってきている。しかし、上述の特開平４－２４０７９２号公報に開示されている方法も含めて、従来の印刷方法では、直径１００μｍ以下であるような微細なビアホールの形成は困難である。

【０００９】さらに、上下層の導体パターン間の確実な

5

電気的接続を得るためには、ビアホールの内部に上下層を接続する電極（以下、ビアホール電極と称する）を形成する必要がある。しかし、従来の方法では、もし直径１００μm以下の微細なビアホールが形成できたとしても、そのような寸法のビアホール内部に電極を形成することは困難である。

【００１０】また、従来の凹版印刷では、一般にガラスやシリコンウエハなどの剛体材料で形成された凹版を使用する。その場合、硬化性樹脂を介してセラミックやガラス基板などの被形成物上に導体パターンを転写する工程において、接着している凹版と被形成物とを剥離しようとしても、凹版の変形がほとんど生じない。その結果、面同士で接着している凹版と被形成物とを剥離しなければならず、強い剥離力が必要になる。

【００１１】この点を解決するために、凹版として金属シートを用いてフレキシブル性を得ることがある。しかし、そのような場合でも、凹版のパターン形状の加工（溝の形成）はウエットエッチングで行われる。このエッチングは等方性エッチングになるために、ラインの幅に対して導体膜が厚い（すなわちラインが高い）ような導体パターンを形成するために必要になるアスペクト比の高い凹版形状の加工ができない。

【００１２】一方、フォトリソグラフィー技術を利用した導体パターンの形成は、半導体技術でよくあるように、ラインの幅が数μm以下で小面積のパターンを形成する場合には有効である。しかし、電子部品で用いられる導体パターンの形成では、一般に比較的大きな面積のパターンを形成することが必要とされる。そのような場合には、導電膜の蒸着、レジストの塗布、露光、現像、エッチング及びレジスト除去などの一連の工程を、大型装置を用いて行わなければならない。その結果、使用する設備が高価であることから、製造コストが増加しがちである。

【００１３】本発明は上記課題を解決するためになされたものであり、その目的は、（１）導体パターンのライン幅が１０μm以下で導電膜の厚さが５μm以上であって、かつライン幅と同程度の寸法のビアホール電極を含むような微細な導体パターンを、低コストかつ高信頼性で形成することができる電子部品の製造方法、（２）導体パターンの設計上の要求に合わせて、パターン中の任意の箇所で導体膜の厚さを他の箇所の値から変えて導体パターンに高低差を設けることができる電子部品の製造方法、（３）上記のような特徴を有する導体パターンを積層化することができる電子部品の製造方法、及び（４）上記のような方法で製造された電子部品、を提供することである。

【００１４】

【課題を解決するための手段】本発明の電子部品の製造方法は、基板上に第１導体パターンを凹版印刷によって形成する電子部品の製造方法であって、（ａ）可とう性

6

樹脂の表面に、溝を該第１導体パターンに対応するパターンで形成して凹版を製造する工程と、（ｂ）該凹版の表面に、該基板と該凹版との剥離を容易にする剥離層を設ける工程と、（ｃ）該溝に導電性ペーストを充填する工程と、（ｄ）該導電性ペーストを乾燥する工程と、（ｅ）該工程（ｄ）で乾燥された該導電性ペーストを再軟化させて乾燥による体積減少分を補うために追加の導電ペーストを再充填する工程と再充填後の該導電ペーストを再乾燥する工程とを所定の回数繰り返す工程と、（ｆ）該凹版と該基板とを所定の範囲の熱及び所定の範囲の圧力を加えることによってラミネートして貼り合わせる工程と、（ｇ）該凹版を該基板から剥離して、該導電ペーストのパターンを該基板上に転写する工程と、（ｈ）転写された該導電ペーストのパターンを焼成して、該第１導体パターンを形成する工程と、を包含しており、そのことによって上記目的が達成される。

【００１５】ある実施例では、前記工程（ａ）で、前記凹版に形成される前記溝の一部を他の箇所より深く形成して、それによって、前記第１導体パターンの一部に高さの差を設ける。

【００１６】他の実施例では、（ｉ）前記第１導体パターンの少なくとも一部を覆う絶縁層を形成する工程と、（ｊ）該絶縁層の表面に第２導体パターンを形成する工程と、（ｋ）該第１導体パターンの該絶縁層によって覆われていない部分に、該第１導体パターンと該第２導体パターンとを電気的に接続する電極を設ける工程と、をさらに包含する。

【００１７】さらに他の実施例では、（ｌ）前記第１導体パターンの少なくとも一部を覆う絶縁層を形成する工程と、（ｍ）該絶縁層の表面に第２導体パターンを形成する工程と、をさらに包含しており、該第１導体パターンのうちで高さが高く形成されている箇所を電極として使用して、該第１導体パターンと該第２導体パターンとを電気的に接続する。前記絶縁層の表面に平坦部を設けるべき箇所に対応する前記第１導体パターンの部分を低く形成してもよい。さらに、前記絶縁層の表面の前記平坦部にＩＣチップをフェースダウン実装する工程をさらに包含してもよい。好ましくは、前記絶縁層が磁性材料によって形成されている。

【００１８】ある実施例では、前記工程（ａ）において、紫外領域の発振周波数を有するレーザを用いて前記溝を形成する。好ましくは、前記レーザがエキシマレーザである。

【００１９】他の実施例では、前記剥離層が、フッ化炭素系の単分子膜である。さらに他の実施例では、前記導電性ペーストに可塑剤が添加されていて可とう性を有している。

【００２０】さらに他の実施例では、前記凹版に形成される前記溝が、側面にテーパ角を有する断面形状を有している。

7

【００２１】さらに他の実施例では、前記基板が、前記基板と、該絶縁基板の少なくとも一方の表面に形成された厚さ２０μm以下の樹脂層とを備え、該樹脂層は熱硬化性樹脂または熱可塑性樹脂である。好ましくは、前記絶縁基板が誘電材料から形成されている。あるいは、前記絶縁基板が磁性材料から形成されている。

【００２２】さらに他の実施例では、前記基板がグリーンシートから形成されている。本発明の電子部品は、基板と、可とう性樹脂のレーザ加工によって形成された凹版を使用した凹版印刷によって該基板上に転写された第１導体パターンと、を備えており、そのことによって上記目的が達成される。

【００２３】ある実施例では、前記第１導体パターンの少なくとも一部を覆う絶縁層と、該絶縁層の表面に形成された第２導体パターンと、該第１導体パターンの該絶縁層によって覆われていない箇所に設けられて、該第１導体パターンと該第２導体パターンとを電気的に接続する電極と、をさらに備える。

【００２４】他の実施例では、前記第１導体パターンの一部に高さの差が設けられている。さらに他の実施例では、前記第１導体パターンの少なくとも一部を覆う絶縁層と、該絶縁層の表面に形成された第２導体パターンと、をさらに備えており、該第１導体パターンのうちで高さが高く形成されている箇所を電極として使用して、該第１導体パターンと該第２導体パターンとを電気的に接続する。

【００２５】前記絶縁層の表面に平坦部を設けるべき箇所に対応する前記第１導体パターンの部分が低く形成されていてもよい。さらに、前記絶縁層の表面の前記平坦部にフェースダウン実装されたＩＣチップをさらに備えていてもよい。

【００２６】

【作用】上記のように、本発明では、基板上に形成された導体パターン（第１導体パターン）を有する電子部品を製造するにあたって、可とう性を有する樹脂の表面に、形成されるべき導体パターンに対応した溝パターンを形成して、凹版を形成する。そして、この凹版に導電ペーストを充填して、乾燥させる。さらに、充填・乾燥工程を繰り返した後に、基板と凹版とをラミネートする。そして、凹版を剥離して導電ペーストのパターンを基板上に転写した後に、導電ペーストを焼成して、所望の導体パターンを形成する。

【００２７】また、第１導電パターンを覆う絶縁層を設けて、その表面に他の導体パターン（第２導体パターン）を形成することもできる。上下層（第１及び第２）の導体パターンの接続にあたっては、両者を接続する電極を別工程で設けることもでき、また第１導体パターンの一部にあらかじめ高さの差を設けて、高く形成された部分を電極として使用することもできる。

【００２８】また、前記絶縁層の表面で特に平坦部とした場所に対応する箇所の第１導体パターンを低く形成することによって、導体パターンの高低変化が絶縁層表面の平坦度に及ぼす影響が軽減されて、平坦度が向上する。したがって、この平坦部分に、ＩＣチップをフェースダウン実装することが容易になる。

8

【００２９】第１導体パターンに対応した溝の形成にあたっては、紫外波長領域で発振するレーザ光、たとえばエキシマレーザを使用できる。

【００３０】また、フッ化炭素系の単分子膜からなる剥離層を凹版表面に設けることによって、凹版と基板との剥離を容易に行うことができるようになる。

【００３１】さらに、導電性ペーストに可塑剤を添加することによって、乾燥工程後でもその可とう性を保つことが可能になる。

【００３２】凹版表面の溝の側面がテーパ角を有するように形成することによって、溝内部に充填された導電ペーストの良好な転写が行われる。

【００３３】転写対象になる基板は、絶縁基板とその表面に形成された樹脂層とからなることが望ましい。絶縁基板表面の樹脂層は、導体パターンの転写時に接着層として機能する。また、絶縁基板の材料としては、製造される電子部品に所望の特性を付与することができるように、誘電材料や磁性材料などを適宜使用することができる。さらに、基板をグリーンシートで形成すれば、表面への樹脂層の形成を省略することができる。

【００３４】

【実施例】以下に、本発明の電子部品の製造方法の実施例を、図面を参照して説明する。

【００３５】（実施例１）本発明の電子部品の製造方法の第１の実施例を、高周波用チップインダクタ１の製造方法を例にとって、図１～１０を参照して以下に説明する。なお、以下の図面で、同じ構成要素には同じ参照番号をつけている。

【００３６】図１（ａ）には本実施例のチップインダクタ１の平面図、図１（ｂ）には図１（ａ）の１Ｂ－１Ｂ′線におけるチップインダクタ１の断面図を、それぞれ示す。

【００３７】チップインダクタ１は２×１．２５㎜の絶縁基板２の中央部付近の表面に形成されたスパイラル状のコイル導体（ライン）３、及び絶縁基板２の両縁部に形成された端子電極４ａ及び４ｂを有している。コイル導体３の外端３ａは、一方の端子電極４ａに接続されている。コイル導体３の内端３ｂは、リード電極６及びビアホール電極７を介してもう一方の端子電極４ｂに接続されている。このリード電極６は、コイル導体３の形成後にそれを覆うように絶縁基板２の表面に形成される絶縁層５の最表面に、さらに設けられている。また、ビアホール電極７は、絶縁層５の最表面に存在するリード電極６と、絶縁層５の最下面に存在するコイル導体３とを接続している。

【００３８】チップインダクタ１は、凹版印刷によって製造される。以下、その製造方法を順に説明する。以下の説明に現れる各工程２１０～３１０は、図2のブロック図に示されている。

【００３９】まず、図3を参照して、使用される凹版２０の製造工程２１０を説明する。凹版２０は、ＸＹステージ１６上に固定された厚さ１２５μｍのポリイミドフィルム１５上に形成される。エキシマレーザ装置１１から出射された紫外領域の波長２４８nmのレーザビームは、形成されるべきコイルのスパイラルパターン及び端子電極のパターンに対応するマスクパターンを有するマスク１２を照射する。マスク１２通過後のレーザビームは、ミラー１３で反射され、イメージングレンズ１４で縮小されて、ポリイミドフィルム１５上を照射する。ポリイミドフィルム１５のうち、レーザビームで照射された部分は光化学反応で分解されて、導体パターンのラインに相当する溝２１（図4参照）が形成される。これによって、所望のパターンに対応した凹版２０が形成される。ＸＹステージ１６を移動させながら上記の照射動作を繰り返すことによって、典型的には、１００㎜×１００㎜のポリイミドフィルム１５上に、サイズ2×１．２５㎜の凹版２０が計４０００個形成される。

【００４０】エキシマレーザによる加工は、炭酸ガスレーザやＹＡＧレーザによる加工が赤外波長領域のレーザビームによる熱分解加工であるのに対して、ピークパワーが数１０MWに達する紫外波長領域のレーザビームによる光分解加工である。また、レーザビームのパルス幅が短いために、加工領域以外の周囲への熱的影響が少ない。その結果、エキシマレーザによる加工では、パターンのライン幅が１０μｍ以下の微細な加工を行うことができる。

【００４１】また、レーザビームが照射された部分のポリイミドフィルム１５の表面は、フィルムを構成する分子の結合が切断されていて、化学的に非常に活性化された状態にある。したがって、その部分では化学結合が起こりやすい。この特徴は、後述する剥離層の形成に有利である。

【００４２】図4は、上記の方法で形成された凹版２０の溝２１の典型的な断面形状を示す。レンズの焦点深度などレーザ加工工程で使用される光学系の特性を適切に調整することによって、溝２１は、その側面が2～６０°のテーパ角を有する台形状の断面形状を有するように形成される。これによって、後の工程で、溝２１の内部に充填される導電ペーストの被形成物上への転写が、容易に実施できるようになる。なお、使用されるレーザビームの形状は、典型的には、エキシマレーザ装置１１からの出射時で８×２４㎜の長方形で、ポリイミドフィルム１５への照射時で３．２×９．６㎜の長方形である。

【００４３】また、凹版２０の材料になるポリイミドフィルム１５の加工表面に適切な保護層を設けることによって、溝２１の形成時に発生するプラズマとの相互作用から凹版２０の加工面を保護することができる。これによって、凹版２０の表面の溝２１の開口部の変形を防ぐことができる。なお、上記目的の保護層の材料としては、例えばポリエチレンテレフタレート（ＰＥＴ）、ポリカーボネート（ＰＣ）、ポリサルフォン（ＰＳＦ）が使用できる。

【００４４】次に、マスク１２をビアホール電極7の形成用のマスクに交換してレーザビームをさらに照射して、先の工程で形成された導体パターンの溝２１の所定の位置に、ビアホール電極7に相当する円筒形のピット２２（図５参照）を形成する。ピット２２の形成にあたっても、溝２１の形成時と同様に微細加工が可能であり、また充填された導電ペーストの転写が容易なように、ピット２２がテーパ形状を有するように形成することができる。なお、円筒形以外の形状を有するピット２２を形成することも可能である。

【００４５】以上の方法によって、幅１０μｍ～５０μｍのラインに相当する深さ２０μｍの溝２１、及び直径４５μｍのビアホール電極に相当する直径６０μｍのピット２２を含む、形成されるべき導体パターンに対応する凹版２０が形成される。溝２１やピット２２の深さは、レーザビームの照射時間だけを変化させることによって、ラインの幅（溝２１の幅）を変えることなく任意に０．２μｍ単位で変更でき、最適な値にすることができる。また、溝２１の幅やピット２２の直径はマスクの寸法を変更することで、容易に調整することができる。これによって、本発明の方法によれば、導体パターンのライン幅を１０μｍ以下にしたり、ビアホールの寸法をそのような微細なラインに対応して小さくしたりすることも可能である。

【００４６】なお、上述のように凹版２０の材料としてポリイミドフィルム１５を用いることによって、本発明によれば、可とう性（フレキシブル性）を凹版２０に持たせることができる。そのことによって得られる効果は、後述する。

【００４７】上記の方法で形成した凹版２０を用いて、導体パターンを被形成物の表面に転写する。しかしながら、凹版２０の材料として使用しているポリイミドフィルム１５では、溝２１及びピット２２の中に充填されて転写される導電ペーストとフィルム１５との剥離性が十分ではない。そのため、転写工程において、溝２１及びピット２２の内部に導電ペーストが残存しやすい。特に、ビアホール電極7に相当するピット２２では、その深さが深いために導電ペーストの残存が特に顕著に発生する。その結果、凹版２０の形状が十分に転写されない結果になる。したがって、実質的に完全な凹版形状の転写を実現するためには、凹版２０の表面、特に溝２１及びピット２２の表面における剥離層の形成工程２２０が必要である。

【００４８】発明者らは、上記問題点を解決するために、ポリイミドフィルム１５に対する剥離処理を、特に導電ペーストに対する剥離力、及び処理層の寿命の点から鋭意検討した。その結果、以下の方法でフッ化炭素系単分子膜の剥離層を形成することが効果的であることを確認した。

【００４９】まず、O_2アッシャーで酸素プラズマを凹版２０の表面に照射して、凹版２０の表面に存在する酸素の密度を多くする。一方、ｎ－ヘキサデカン（あるいは、トルエン、キシレン、ジシクロヘキシルでもよい）８０％、四塩化炭素１０％及びクロロホルム８％の混合溶液中に、フッ化炭素基及びクロロシラン基を含む物質を混ぜた非水性の溶媒、例えば$CF_3(CF_2)_7(CH_2)_2SiCl_3$を、約１％の濃度で溶かした溶液を調製する。この溶液中に、上記のように酸素処理された凹版２０を浸漬して、凹版２０の表面に酸化膜を形成する。この酸化膜の表面には水酸基が多数含まれており、フッ化炭素基及びクロロシラン基を含む物質のＳｉＣｌ基と反応して、脱塩素反応が生じる。この結果、凹版２０の表面に共有結合によって化学吸着したフッ化炭素系単分子膜が、凹版２０の表面全体にわたって形成される。この単分子膜が、剥離層２３（図５参照）として効果的に機能する。

【００５０】剥離時に大きな剥離力を必要とする箇所は主に溝２１及びピット２２の部分であり、剥離層２３は主としてそのような部分に形成されることが望ましい。一方、先に述べたように、凹版２０を構成するポリイミドフィルム１５のうち、エキシマレーザによる加工で溝２１及びピット２２が形成された部分は、化学的に活性な状態にある。結果として、上記のフッ化炭素系単分子膜の剥離層２３は、剥離時に大きな剥離力が必要とされる溝２１及びピット２２の内部に、より多く結合して形成される。また、剥離層２３と凹版２０、すなわち上記の単分子膜とポリイミドフィルム１５との結合は共有結合であるので、両者は非常に強力に結合しており、剥離効果の耐久性がある。さらに、剥離層２３の厚さは１００～１０００オングストロームと薄いために、凹版２０の形状精度に影響を与えず、凹版２０内部に多くの導電ペーストを充填することができる。

【００５１】このように、工程２２０で凹版２０の表面に形成される剥離層２３は、非常に優れた特性を有するものである。

【００５２】次に、工程２３０として、以上のように表面に剥離層２３が形成された凹版２０の表面に、導電ペーストとしてＡｇペースト２４を塗布する。そして、塗布後の凹版２０表面をスキージ２５で掻くことによって、凹版２０表面の余分なＡｇペースト２４を除去するとともに、溝２１及びピット２２の中にＡｇペースト２４を十分に充填する（図５参照）。

【００５３】ここで、発明者らによって行われた使用するスキージ２５の材質に関する検討によれば、本発明では、以下の理由によりセラミック製のスキージ２５の使用が望ましいことが明らかになった。すなわち、樹脂製またはスチール製のスキージは、Ａｇペースト２４中に含まれる異物や凹版２０の表面に存在するほこりなどによって傷つきやすい。そのため、そのようなスキージ表面のきずによって、凹版２０表面が傷つきやすくなって、凹版２０の寿命が低減する。それに対して、セラミック製のスキージ２５は硬いために、異物やほこりによる先端部の損傷が少ない。さらに、２０００番以上の細かい研磨材でセラミック製スキージ２５の先端部を滑らかにすれば、長時間の摩耗による消耗も防ぐことができる。この結果、セラミック製のスキージ２５は、凹版２０の表面を傷つけることが少ない。

【００５４】次に、Ａｇペースト２４を充填した凹版２０を循環式熱風乾燥機を用いて乾燥させて、Ａｇペースト２４中の有機溶剤を蒸発させる（工程２４０）。これによって、凹版２０の溝２１及びピット２２に充填されたＡｇペースト２４を、溝２１及びピット２２の形状によりフィットさせて、よりシャープな形状を得ることができる。なお、乾燥手段は、上記に限られるものではない。

【００５５】本実施例で扱っている凹版２０の表面には比較的深い溝２１及びピット２２が形成されており、特に、ピット２２は最大深度が６０μｍと深い。そのため、この乾燥工程２４０において１００℃以上の温度で凹版２０を急速に乾燥させると、溝２１及びピット２２の内部に充填されているＡｇペースト２４に直径５～４０μｍのピンホールが発生しやすい。ライン幅が５０μｍ以下であるような微細な導体パターンでは、このようなピンホールはパターン焼成後のオープン不良の原因になり、良質な導体パターンの形成を妨げる。

【００５６】そこで、本発明の乾燥工程２４０では、以下のように２段階に凹版２０の乾燥を行う。すなわち、まず１００℃以下の温度で５分間の予備乾燥を行い、続いて温度１５０℃で５分間の乾燥を行う。それによって、上記のようなピンホールの発生を防ぐことができ、焼成後のオープン不良の発生がない導体パターンの形成が可能になる。

【００５７】上記の予備乾燥の実施に換えて、室温から１５０℃までの昇温を１５℃／分以下の緩やかな温度勾配で行うことによっても、上記と同様のピンホール発生の抑制という効果を得ることができる。

【００５８】なお、溝２１やピット２２の内部のＡｇペースト２４を上記の工程２４０で乾燥または硬化させると、その柔軟性が失われやすい。その結果、微細なライン幅（例えば１００μｍ以下）を有する導体パターンを転写する場合には、転写時に発生するストレスによってＡｇペースト２４にクラックが発生して、焼成後のオープン不良の原因になることがある。このような不都合を

防ぐため、本発明ではＡｇペースト２４中に０．１～１０wt%の可塑剤を添加する。これによって、Ａｇペースト２４が乾燥後にも適度な柔軟性を有するようにして、転写工程でのクラックの発生を防ぐことができる。可塑剤としては、フタル酸エステル系の可塑剤、例えば、フタル酸ジメチル、フタル酸ジエチル、あるいはフタル酸ジオクチルを使用することができる。

【００５９】以上のような乾燥工程２４０を行うと、有機溶剤の蒸発分に相当するだけ、溝２１やピット２２の内部に充填されているＡｇペースト２４の体積が減少する。そこで、この減少分を補うために、Ａｇペースト２４の充填工程及び乾燥工程をもう一度繰り返す。先の乾燥工程２４０で有機溶剤が蒸発することによって一度硬化したＡｇペースト２４は、この再充填で再び軟化する。この再充填工程２５０及び再乾燥工程２６０によって、充填されているＡｇペースト２４の形状をさらに良好なものに整えるとともに、Ａｇペースト２４の厚さを凹版２０の溝２１及びピット２２の深さと同等にすることができる。

【００６０】凹版２０の非パターン部、特にそれぞれの溝２１の間の部分にＡｇペースト２４が残存していると、導体パターンのライン間の短絡不良の原因になり得る。このようなＡｇペースト２４の残存は、Ａｇペースト２４が粘性を有していて糸をひきやすいために、スキージ２５による引っかき動作中に糸ひき現象が発生して、除去されるべき部分にＡｇペースト２４が残存してしまうことによる。しかし、上記のように、再充填工程２５０において、溝２１及びピット２２の内部に乾燥状態のＡｇペースト２４が存在する状態で再充填を行うと、非パターン部に新規に塗布されたＡｇペースト２４の溶剤が溝２１やピット２２の内部の乾燥状態のペーストに吸収されて、非パターン部に残存していたＡｇペースト２４の粘度が増加する。この結果、非パターン部のＡｇペースト２４をスキージで除去する場合に糸ひき現象が発生せず、この部分の残存ペーストが容易に除去される。そのため、ライン間の短絡不良が生じない導体パターンの形成を行うことができる。

【００６１】なお、本実施例の説明では、再充填工程２５０及び再乾燥工程２６０はそれぞれ１回ずつ繰り返されるが、必要に応じてそれらを２回以上繰り返すことも可能である。

【００６２】次に、絶縁基板２上に熱可塑性樹脂層２８を形成して、導体パターンが転写される被形成物を得る。この樹脂層２８は、転写時の接着層として機能する。そして、図６に模式的に示されているように、Ａｇペースト２４が充填された溝２１及びピット２２を有する側の凹版２０表面と熱可塑性樹脂２８とを対向させて、凹版２０と絶縁基板２とをラミネートする（工程２７０）。

【００６３】後述するように、熱可塑性樹脂層２８の厚さが極端に厚くなると、焼成時に樹脂層２８自身の燃焼ガスが多量に発生して、導体パターンがうまく形成されないという問題点が発生する。発明者による検討の結果、樹脂層２８の厚さは２０μｍ以下が適当であることが確認されている。

【００６４】ラミネート工程２７０の温度は、使用する樹脂層２８のガラス転移温度より３０℃低い温度から、１００℃高い温度の範囲内に設定することが望ましい。ラミネート温度が上記上限値より高いと、樹脂層２８の流動性が大きくなりすぎて、ラミネート時の圧力によって樹脂層２８が薄くなり、凹版２０の溝２１及びピット２２からのＡｇペースト２４の転写が良好に行われなくなる。一方、ラミネート温度が上記下限値より低い場合には樹脂層２８の流動性が十分でなく、Ａｇペースト２４と樹脂層２８との密着性が悪くなって、やはり転写が良好に行われない。

【００６５】さらに、ラミネート時の圧力は、１kg／cm^{2}から絶縁基板２の割れが発生する限界圧力値までの範囲に設定することが望ましい。圧力値が上記下限値より小さいと、絶縁基板２の表面にうねりがある場合に、ラミネート時の凹版２０と絶縁基板２との間が完全に密着せず両者の間に気泡が混入することがある。そのような現象は、やはり転写不良につながることがある。

【００６６】上記の検討結果を考慮して、本実施例では、ラミネート工程２７０を以下の条件で行う。

【００６７】まず、熱可塑性樹脂であるポリビニールブチラール樹脂（以下、ＰＶＢと略記する）を溶解したブチルカルビトールアセテートの溶液を、１００mm角のアルミナ製の絶縁基板２の表面に塗布して乾燥する。これによって、絶縁基板２の表面全体に厚さ１０μｍのＰＶＢ層２８を形成する。次に、このようにＰＶＢ層２８を形成した絶縁基板２と、Ａｇペースト２４を充填してある凹版２０とを、図６に示すように熱ローラ２６及び２７を用いて、温度１００℃、圧力２０kg／cm^{2}及び速度５cm／秒の条件下でラミネートする。なお、ＰＶＢ層２８は、ディップ法、スピンナー法、あるいはロールコースタを用いるコーティング法を用いて塗布すればよい。本実施例では絶縁基板２の片面にのみＰＶＢ層２８を形成したが、両面に形成しても良い。

【００６８】通常、絶縁基板２の表面には、図７（ａ）または図７（ｂ）に模式的に示すように、最大幅３０μｍ程度のうねりが存在する。従来のようにガラス製の凹版２９を使用する場合には、図７（ｂ）に示すように、ガラス凹版２９の剛性が強すぎるために、凹版２９が絶縁基板２のうねり形状に十分に追従できない。そのため、ＰＶＢ層２８′の厚さを１０～５０μｍ程度に不均一にしてうねりを吸収して、ラミネートを行わねばならない。このため、先に述べた好ましい厚さの範囲内（２０μｍ以下）におさまるように、ＰＶＢ層２８′を形成することができない。

15

【００６９】しかし、本発明のようにフレキシブル性に富んだ樹脂製の凹版２０を使用する構成によれば、図７（ａ）に示すように、凹版２０が絶縁基板２のうねり形状に十分に追従できる。したがって、絶縁基板２のうねり形状には無関係に、厚さ１０μm以下のＰＶＢ層２８を絶縁基板２上に形成することができる。

【００７０】次に、転写工程２８０として、ラミネートされた凹版２０と絶縁基板２との温度を室温にまで下げてから凹版２０を絶縁基板２から剥離させて、導体パターンに応じてパターン化されたＡｇペースト２４の転写を行う。

【００７１】このとき、本発明の構成では、凹版２０がフレキシブル性に富んでいるために、図８に示されるように凹版２０を９０°以上の角度に曲げることが可能である。その結果、絶縁基板２からの凹版２０の剥離は面と線との剥離になる。このため、必要な剥離力が低減されて、凹版２０を容易に剥離することができる。一方、従来の剛性が強いガラス製凹版２９（図７（ｂ）参照）を用いる場合には、図８に示すような角度まで凹版２９を曲げることができず面と面との剥離になるので、大きな剥離力が必要である。また、凹版２９の曲げ角度を大きくし過ぎると、凹版２９または絶縁基板２にクラックが容易に発生する。したがって、両者の剥離には多大の注意が必要であって、作業性が良くなく、作業コストや作業時間の増加を生じていた。

【００７２】本発明によれば、例えば溝の幅１５μm、深さ２０μmのパターンを有する凹版２０を用いても、溝２１の内部でのＡｇペースト２４の残存がなく、上記の溝２１の幅と実質的に同じ幅及び溝２１の深さと実質的に同じ高さを有する導体パターンを転写・形成することができる。また、ビアホール電極部分に関しては、凹版２０のピット２２の直径が４５μmで深さが６０μmの場合に、溝２１の場合と同様に実質的に完全に対応する寸法の導体パターンを転写・形成することができる。また、導体ラインとビアホール電極とは、同一工程で一体的に同時に形成されるので、両者の間の電気的接続が確実に確保される。

16

【００７３】さらに、本実施例の高周波用チップインダクタ１のように高周波数領域で使用される電子部品では、表皮抵抗を小さくして電気的動作特性を向上させるために、導体パターンの表面形状をできるだけシャープにする必要がある。しかし、従来の銅板やガラス製の凹版の形成に用いられていた湿式エッチングは等方性のエッチングになってしまうので、アスペクト比の高い加工ができない。そのため、パターンが微細になって形成すべきライン幅が細くなるにつれて、深い溝を形成することができなくなる。また、溝のエッジ部が鋭利にならずに円みを帯びてしまう。それに対して、本発明のようにエキシマレーザによって凹版２０を加工すれば、鋭角的なエッジを有するパターンを形成することができる。さらに、すでに説明してきたように、転写時に溝２１やピット２２の内部にＡｇペースト２４が残存しないので、鋭角的な凹版２０の形状と同様の鋭利な形状を有するパターンが転写される。したがって、本実施例にしたがって形成された導体パターンは、高周波用導体として優れた特性を有するものになる。

【００７４】次に、上記のように導体パターンが転写された絶縁基板２を、図９に示すようなピーク温度８５０℃の温度パターンの下で焼成する工程２９０を行う。本発明で焼成の対象になる絶縁基板２は、ＰＶＢ層（樹脂層）２８を介して導体パターンが形成されている構造になるので、焼成条件の設定によってはＰＶＢ層２８から燃焼ガスが発生して、導体パターンの不良につながる剥離や変形が生じることがある。そのような不都合の発生を防ぐためには、ＰＶＢ層２８の燃焼が開始されてから終了するまでの温度に相当する２００℃～５００℃の間の昇温時の温度勾配を２００℃／時間以下にすることが望ましい。

【００７５】ラミネート工程２７０の説明に関連してすでに若干説明したが、このような条件で焼成工程２９０を実施する場合におけるＰＶＢ層２８の厚さと形成された導体パターンの性能との関係を、（表１）に示す。

【００７６】

【表１】

PVB膜厚	焼成後パターン形状	焼成後パターンはがれ
10μm	○	○
20μm	○	○
30μm	×	△
50μm	×	×
100μm	×	×

評価基準

アルミナ基板100mm角内（2×1.25mmサイズ400個）中

○－－－95％以上良品

△－－－70％以上良品

×－－－良品70％以下

【００７７】（表１）より、ＰＶＢ層２８の厚さが２０μｍ以下であれば、形状の劣化や剥離が生じることなく所望の導体パターンを焼成することができる。しかし、ＰＶＢ層２８の厚さが３０μｍ以上になると、焼成時にパターンの形状不良や剥離が発生することがわかる。したがって、ＰＶＢ層２８の厚さは薄いほうが特性的に有利である。これより、先に図７（ａ）及び図７（ｂ）を参照して比較した本発明のポリイミド凹版２０と従来のガラス凹版２９とでは、ＰＶＢ層２８の厚さを上記の望ましい範囲内におさめることができる本発明のポリイミド凹版２０の方が、品質的に優れた導体パターンを形成できることになる。

【００７８】また、上記のような本発明の方法によれば、導体パターン中のライン３とビアホール電極７とが、一体的に同時に形成される。これによって、ライン３とビアホール電極７との間の確実な電気的接続が得られる。

【００７９】次に、以上の工程で表面にＡｇペースト２４による導体パターンを形成した絶縁基板２の表面に、絶縁層５を形成するために、ガラスペーストのパターンを印刷して形成する（工程３００）。このとき、ビアホール電極７の部分は、マスク径１５０μｍのスクリーン版を使用して、粘度２０万cpsの結晶化ガラスによって印刷する。これより、ビアホール電極７の部分には印刷の「にじみ」が発生して、ビアホール電極７の周囲を覆うガラスペーストの厚さが他の部分よりも薄くなる。この結果、ビアホール電極７の周囲に、ビアホール形状が形成される。

【００８０】形成されるビアホールの径はビアホール電極の形状によって規定されるので、これまでは形成が困難であった直径４０μｍ程度の微少なビアホールであっても、本発明によれば、簡単に印刷形成することができ＊る。また、このように微少なビアホールを形成できるので、その分だけスパイラル状のコイルパターンのターン数を増加させることができる。これによって、得られるインダクタンス値を大きくすることができる。

【００８１】上記のように印刷されたガラスペーストのパターンを、ピーク温度８２０℃に１０分間保持して焼成し、絶縁層５を形成する。このとき、結晶化ガラスを使用しているので、焼成中の流動が少なく、印刷されたパターン形状が良好に保たれる。

【００８２】従来の方法では、多層構造基板の上下層導体パターンを相互に接続するために、絶縁層にスクリーン印刷によるパターニングまたはエッチングなどによって開口部を設けてビアホールとし、さらにそこに電極材料を埋め込んでビアホール電極を形成していた。しかし、この方法では、電極の埋め込み工程における不良によって、上層または／及び下層の導体パターンとビアホール電極との電気的接続が十分でないことによる下層の導体パターンと上層の導体パターンとの間の接続不良が発生することがあった。しかし、本発明による方法では、すでに述べたように、ビアホール電極７の形成は下層の導体パターンの形成と一体的に同時に行われるので、上記のような接続不良は発生しない。

【００８３】さらに、ビアホール電極７の形状・厚さを任意に設定できるので、絶縁層５の表面からビアホール電極７を数μｍ突き出させるような形状にすることによって、上層導体パターンとビアホール電極７との接続を確実に行うことができる。また、ビアホール電極７の基板２表面に垂直な方向の断面形状を台形状にすることによって、寸法的に微細なビアホール電極７であっても、後工程で必要とされるだけの接続強度が十分に得られる構造になっている。

【００８４】最後に、絶縁層５上にリード電極６を形成

する工程３１０を行う。これは、Ａｇペーストでリード電極６のパターンを絶縁層５表面にスクリーン印刷して、ピーク温度８１０℃に１０分間保持して焼成を行うことによって、形成される。これによって、本実施例のチップインダクタ１が製造される。

【００８５】上記の説明では、チップインダクタ１を例にとって本実施例の電子部品の製造方法を説明してきたが、製造できるのはチップインダクタ１に限られるわけではないのはもちろんである。例えば、本発明に従って、チップビーズ、ＥＭＩフィルタ、コンデンサなどの他の電子部品、あるいは積層構造を有する他の電子部品の電極部分を製造することができる。

【００８６】また、上記の説明では、工程２１０～２９０によって導体パターンを転写して形成した後に工程３００及び３１０で絶縁層５及びリード電極６の形成を行っている。あるいは、このような構造が不要な導体パターンを形成する場合には、工程２１０～２９０までを行えば所望の導体パターンが得られるのであって、工程３００及び３１０を行う必要がない。

【００８７】また、導体パターンを形成するために使用する導電ペーストの材料としてＡｇペーストを使用したが、これに限定されるものではない。例えば、Ｃｕ，Ｎｉ，Ａｌ，Ａｕなどの他の金属ペースト、またはレジネートペーストを使用することができる。また、有機溶剤を含む導電ペースト以外にも、紫外線硬化性樹脂または熱硬化性樹脂で硬化後に適当なフレキシブル性を有する樹脂を含有する導電ペーストを使用することもできる。

【００８８】凹版２０の材料としては、適度の可とう性（フレキシブル性）を有するものであれば、上述のポリイミドフィルム１５の他に、ＰＥＴ、ＰＳＦ、ＰＣ、ＰＥＩ（ポリエーテルイミド）、ＰＡＲ（ポリアクリレート）、ＰＥＥＫ（ポリエーテルケトン）などの樹脂シートを使用することができる。また、絶縁基板２上に形成する樹脂層２８の材料には、エチルセルロース系の熱可塑性樹脂、あるいはエポキシやアクリル系の熱硬化性樹脂を使用することができる。

【００８９】さらに、以上の説明では、凹版２０と絶縁基板２とのラミネート工程において、熱ローラ２６及び２７を用いて圧力をかけながら熱的に貼り合わせる装置を使用したが、少なくとも片面に熱板を備えたプレス装置を使用してもよい。

【００９０】導体パターンを転写して形成するための被形成物を構成する絶縁基板２の材料は、特定のものに制限されるものではなく、セラミックなど一般的に使用されている材料を用いることができる。あるいは、チタン酸バリウムを主体とする誘電体であってもよい。

【００９１】特に、インダクタンス部品を形成する場合には、絶縁基板２及び絶縁層５の少なくとも一方を、フェライトなどの磁性体材料で形成することが望ましい。これは、これらの磁性体材料の透磁率によって、形成される電子部品のインダクタンス値を向上できるからである。

【００９２】あるいは、被形成物をグリーンシートによって形成することができる。グリーンシートは加熱によって軟化する性質を有しているので、グリーンシートを用いて被形成物を形成する場合には、工程２７０において、転写時の接着層として機能する樹脂層２８の形成を省略することができる。

【００９３】凹版２０の形成にはエキシマレーザ装置１１を使用したが、波長が紫外線領域のレーザビームを発することができるものであれば、色素レーザや自由電子レーザなど他のレーザ源を使用することができる。さらに、上記波長領域でこれらのレーザと同等の必要なレベルのエネルギー密度を有するビームを発することができる光源であれば、レーザ源以外の他のものを使用することも可能である。

【００９４】（実施例２）本発明の電子部品の製造方法の第２の実施例を、導体パターンの積層構造を有するハイブリッドＩＣ（以下、ＨＩＣと略記する）基板の製造方法を例にとって、図１１～図１４を参照して説明する。なお、図１１～図１４において、同じ構成要素には同じ参照符号をつけている。

【００９５】図１１（ａ）はＨＩＣ基板３０の平面図、図１１（ｂ）は図１１（ａ）の１１Ｂ－１１Ｂ′線におけるＨＩＣ基板３０の切断面である。なお、図１１（ａ）の右半分は上層の導体パターンが形成されている部分、左半分は下層の導体パターンが形成されている部分を示している。また、図１１（ａ）及び図１１（ｂ）はＨＩＣ基板３０の構成を簡略化して模式的に示すものであるので、図面中の導体パターンは以下に記す寸法の値を正確に反映していない。

【００９６】ＨＩＣ基板３０は、絶縁基板３１上に形成された下層導体パターン３２、下層導体パターン３２を覆うように形成された絶縁層３３、及び絶縁層３３の上に形成された上層導体パターン３４からなる２層配線構造を有している。下層導体パターン３２は、図１１（ｂ）からわかるように、スパイラル状のコイル導体部３２ａ、及びそれ以外の導体部３２ｂを含んでいる。下層導体パターン３２と上層導体パターン３４とは、ビアホール電極３５によって接続される。また、上層導体パターン３４の一部には、ＩＣチップをフェースダウン実装するための実装部３６が設けられている。

【００９７】下層導体パターン３２のうちでコイル導体部３２ａに相当する部分には、電気的特性の観点から、例えばピッチ６０μｍ（すなわち、各ラインの幅３０μｍ、ラインの間隔３０μｍ）で高さ（すなわち、導体膜の厚さ）３５μｍの導体パターンが形成される。また、ビアホール電極３５は、絶縁層３３の表面から先端が飛び出して上下層の導体パターン３２及び３４の間が確実に接続されるように、高さ（すなわち、導体膜の厚さ）

５０μｍに形成されている。一方、上層導体パターン３４のフェースダウン実装部３６は、例えば、ピッチ１５０μｍ（すなわち、各ラインの幅７５μｍ、ラインの間隔７５μｍ）で形成される。

【００９８】さらに、このフェースダウン実装部３６は、ＩＣチップをフェースダウン実装する際の実装条件の制約から、表面の長さ５㎜あたりのうねりが３μｍ以下であるような平坦度が必要である。この場合、下層導体パターン３２のうちでフェースダウン実装部３６の下に位置する導体部３２ｂの高さ（導体膜の厚さ）が５μｍ以上あると、絶縁層３３の表面のうねりが大きくなってフェースダウン実装が困難になる。そのために、導体部３２ｂの高さは、５μｍ以下に抑えられている。

【００９９】以上のように、本発明の第２の実施例では、形成される導体パターンのうちで任意の場所の導体膜の厚さ（ラインの高さ）を所望のレベルに変えて、パターン内に高低差を有する導体パターンが形成される。これによって、最表面の上層導体パターン３４の所定の位置へのＩＣチップのフェースダウン実装を可能にしたＨＩＣ基板３０が形成される。

【０１００】以下に、本実施例のＨＩＣ基板３０の製造方法を説明する。なお、以下の説明における凹版の製造などの個々の工程は、形成対象である導体パターンの形状が異なるだけで第１の実施例に対応する各工程と実質的に等価である。したがって、その特徴などに関する詳細な説明は省略する。

【０１０１】まず、下層導体パターン３２を形成するための凹版を、第１の実施例の工程２１０と同様に、下層導体パターン３２のコイル導体部３２ａ作成用及びその他の導体部３２ｂ作成用、ならびにビアホール電極３５作成用の計３種類のマスクを使用して、エキシマレーザを用いてポリイミドフィルム上に以下の順序で形成する。まず、コイル導体部３２ａのパターンに対応するマスクを用いて、深さ４５μｍの溝からなるコイル導体部３２ａに相当するパターンを形成する。次に、ビアホール電極３５のパターンに対応するマスクを用いて、深さ６５μｍの溝からなるビアホール電極に相当するパターンを形成する。最後に、導体部３２ｂのパターンに対応するマスクを用いて、深さ１０μｍの溝からなる導体部３２ｂに相当するパターンを形成する。上記の各工程で形成されるそれぞれのパターンの相対的位置を５μｍ以内の精度で位置合わせすることによって、下層導体パターン３２を形成するための凹版が形成される。

【０１０２】このように形成された凹版上に、第１の実施例の工程２２０と同様にフッ化炭素系単分子膜からなる剥離層を形成する。次に、第１の実施例の工程２３０と同様に、セラミック製スキージを用いて、Ａｇペーストを凹版のそれぞれの溝に充填する。その後に、工程２４０と同様に、循環熱風式乾燥機によってＡｇペーストを乾燥して内部に含まれる有機溶剤を蒸発させて、凹版の溝の内部のペーストを蒸発量に相当する体積分だけ減少させる。さらに、工程２５０及び２６０と同様に、Ａｇペーストを再充填した後に２段階の乾燥を行う。このように、第１の実施例と同様にペーストの充填及び乾燥工程を繰り返すことによって、Ａｇペーストの膜の厚さをそれぞれの溝の深さと実質的に等しくすることができる。

【０１０３】次に、工程２７０と同様に、厚さ１０μｍの熱可塑性樹脂層を絶縁基板３１表面に形成して、凹版と絶縁基板３１とを圧力２５kg／㎠、基板温度１３０℃で貼り合わせる。その後、工程２８０と同様に、基板温度を室温まで下げて凹版を剥離して、導体パターンを絶縁基板３１上に転写する。さらに、工程２９０と同様に、導体パターンを転写した絶縁基板３１をピーク温度８５０℃まで２００℃／時間の温度勾配で昇温して、焼成処理を行う。

【０１０４】以上の一連の工程によって、第１の実施例の場合と同様に、下層導体パターン３２及びビアホール電極３５が一体的に同時に形成される。

【０１０５】次に、工程３００と同様に、ガラスペーストのスクリーン印刷によって、絶縁基板３１の上に絶縁層３３のパターンを形成する。そして、温度８４０℃で焼成して、絶縁層３３を形成する。このとき、第１の実施例と同様に結晶化ガラスを使用することによって、焼成中のガラスペーストの流動が少なく、スクリーン印刷で形成した形状が比較的良好に保たれている。

【０１０６】次に、絶縁層３３の形成後に、上層導体パターン３４に相当するパターンをＡｇペーストのスクリーン印刷によって形成する。そして、ピーク温度８１０℃に１０分間保持する焼成処理によって、上層導体パターン３４を形成する。

【０１０７】上記のようにして、導体パターンのうちで、スパイラル状のコイル導体３２ａに相当する部分のラインの高さ（導体膜の厚さ）を大きくすることで、第１の実施例と同様の電気的特性に優れたコイルが形成される。また、ビアホール電極３５の基板表面に垂直な方向での断面を台形状にすることによって、上層導体パターン３４と下層導体パターン３２との電気的接続を確実に行うことができる。また、下層導体パターン３２の厚さを任意の所定の箇所で選択的に薄くすることによって、絶縁層３３の表面の平坦化が必要な箇所における所望の平坦化を実現できる。これによって、ＩＣチップのフェースダウン実装が可能なＨＩＣ基板３０が製造される。

【０１０８】ビアホール電極３５の形状は、図１１（ｂ）に示す形状に限られるものではない。例えば、図１２に示すＨＩＣ基板４０のように、ビアホールの一部分のみを埋めるような形状の電極３５′を形成することもできる。あるいは、絶縁層３３の形成時にビアホールを設けて下層導体パターン３２が絶縁層によって完全に

覆われないようにして、下層導体パターン３２及び上層導体パターン３４を接続する電極を、下層導体パターン３２の形成工程とは別の工程でビアホール内に設けてもよい。

【０１０９】さらに、上記の説明では、２層配線基板を例にとって説明を行ったが、さらに多層化をはかることも可能である。例えば図１３に示すＨＩＣ基板５０では、それぞれが図１１（ｂ）あるいは図１２に示したＨＩＣ基板３０及び４０の一層のパターンに相当する導体パターン５１，５２及び５３が、絶縁基板３１の上に３層積層されている。

【０１１０】さらに、本実施例によれば、導体パターンのラインに高低差を設けられるので、図１４に示すような絶縁層３３の表面形状を有するＨＩＣ基板６０を形成することもできる。ＨＩＣ基板６０では、下層導体パターンのうち、絶縁層３３の表面のうねり形状の制御が不要な部分に相当する導体部３２ａを、比較的高いライン（厚い導体膜）によって形成している。一方、ＩＣチップ６１をフェースダウン実装する部分のように絶縁層３３の表面を平坦にする必要がある部分に相当する導体部３２ｂを、比較的低いライン（薄い導体膜）によって形成している。導体部３２ｂの高さが低くなると導体抵抗が増加するが、必要に応じて導体部３２ｂのラインの幅を大きくすることによって、電気的特性に対する悪影響をおさえることができる。

【０１１１】このように、本発明によれば、絶縁層３３の表面形状に対する要求と導体パターンの電気的特性に対する要求とのトレードオフを考慮して、導体パターンの最適な形状を得ることができる。

【０１１２】以上のように、本発明の電子部品の製造方法によれば、フレキシブル性に富んだ樹脂シートの表面に、形成されるべき導体パターンに対応した溝パターンをエキシマレーザの照射によって形成して、凹版を製造する。凹版の溝部パターンに充填される導電ペーストは、被形成物である基板上に実質的に完全に転写される。また、凹版に形成する溝の形状を鋭利にすることができるので、転写後の焼成によって形成される導体パターンの形状も、所望の鋭利な矩形状になる。これによって、形成される導体パターンの電気的特性が改善される。

【０１１３】サイズの面では、導体パターンのラインの幅が１０μｍ以下で、導体膜の厚さが５μｍ以上であるような、微細かつ厚膜の導体パターンの形成が可能である。また、任意の所定の箇所についてのみ導体膜の厚さを厚くする、すなわち導体パターンのラインを高くすることができる。これらの点を応用することによって、本発明の電子部品の製造方法によれば、微細な導体パターンのサイズと実質的に同等な程度に幅が微少なビアホールの形成が可能である。したがって、従来の印刷方法では実現が困難であった小型の積層構造を有する電子部品を、低コストで製造することができる。

【０１１４】なお、以上の第１及び第２の実施例の説明では、導体パターンの中に導体膜の厚い部分を作成することが必要とされるタイプの電子部品を例にとって、本発明を説明してきた。しかし、それ以外の電子部品、すなわち、特に導体膜の厚さを部分的に異ならせる、あるいは厚くすることが必要でないような電子部品に対しても、本発明の電子部品の製造方法を適用できることは明らかである。そのような場合であっても、フレキシブルな樹脂シートから形成された凹版の使用によって転写工程での剥離が容易かつ確実に行えること、また、エキシマレーザによる凹版上のパターン形成により鋭利な矩形状のパターンが形成できることは、製造される電子部品の特性にとっては十分に有効な改善手段になる。

【０１１５】

【発明の効果】以上に説明してきたように、本発明によれば、可とう性に富んだ樹脂からなる凹版を用いることによって、基板の損傷や導体パターンにおけるクラックやピンホールの発生を招くことなく、凹版の剥離・導体パターンの転写が行われる。また、基板表面にうねりがあっても、凹版がそのうねり形状に追従して変形できるので、基板と凹版とが密着して、導電ペーストの転写が良好に行われる。また、導電ペーストの転写が完全に行えるので、導体パターン中のライン幅が細く、かつ導体膜の厚さが厚いパターンであっても、良好な形状で形成する。さらに、凹版への導電ペーストの充填及び乾燥を複数回行うことによって、乾燥によって導電ペーストの体積が減少しても、充填される導電ペーストの形状を溝の形状によりフィットさせることが可能になる。また、凹版と基板とのラミネートを熱的に行うことによって、不透明な基板上にも導体パターンの転写を行える。

【０１１６】さらに、導体パターンの多層構造化も、容易に実現される。また、導体パターンの任意の箇所の導電膜の厚さを容易に制御することが可能であるので、電気特性や絶縁層表面の形状などの最適化を図ることができる。例えば、導体パターン中で高く形成された部分を、多層構造の各導体パターンを接続する電極として使用することができる。これによって、導体パターンと電極とが一体的に同時に形成されるので、両者の間の接続不良などの欠陥の発生が防がれる。あるいは、導体パターンを低く形成することによって、その部分に対応する絶縁層表面の平坦度が向上する。これによって、ＩＣチップのフェースダウン実装に必要な平坦部を得ることができる。

【０１１７】凹版表面の溝の形成を紫外波長領域の発振周波数を有するレーザ、好ましくはエキシマレーザで行うことによって、凹版上に微細パターンが容易にかつ高精度に形成される。また、溝の深さの変更は、レーザの照射時間の変更によって容易に行われる。さらに、凹版に形成する溝の形状を鋭利にすることができるので、転

写後の焼成によって形成される導体パターンの形状も、所望の鋭利な矩形状になる。これによって、形成される導体パターンの電気的特性が改善される。

【0118】フッ化炭素系単分子膜の剥離層は、凹版の表面に容易に形成される。この剥離層は、凹版表面に共有結合によって結合しているために耐久性があり、その結果が持続する。また、単分子層であるために剥離層は薄く、凹版の形状に影響を与えない。

【0119】導体ペーストに可塑剤を添加して可とう性をもたせることによって、凹版がフレキシブルに屈曲しても追従することが可能になる。さらに、乾燥工程後であっても適度な可とう性を有することができるので、転写時のストレスに十分に対抗でき、導電ペーストにおける欠陥の発生が防がれる。

【0120】凹版にテーパをもたせることによって、充填された導電ペーストの剥離・転写をさらに容易にすることが可能になり、良好な形状の導体パターンが形成される。

【0121】基板として表面に樹脂層を設けた絶縁基板を用いる場合、その樹脂層を導電ペーストパターン転写時の接着層として使用することができるが、特に樹脂層の厚さを20μm以下にすることによって、熱的なラミネート時に樹脂層自身から発生する燃焼ガスの影響による導体パターンの欠陥の発生が抑制される。絶縁材料として誘電材料や磁性材料を使用すれば、形成される電子部品に所望の特性を付与することが可能になる。また、基板をグリーンシートによって形成すれば、ラミネート時に加えられる熱によってグリーンシートが軟化する性質を利用することができ、接着層として機能する樹脂層の形成を省略することが可能になる。

【0122】さらに、本発明によって形成される電子部品では、高精度で微細な導体パターンが容易に形成されるとともに、多層構造化も容易に行われる。また、各層の導体パターン間を接続する電極を導体パターンと一括して形成することができ、確実な電気的接続を得ることができる。

【図面の簡単な説明】

【図1】（a）本発明の一実施例におけるチップインダクタの模式的な平面図

（b）（a）の1B－1B′線における断面図

【図2】同電子部品の製造方法の工程の流れを示すブロック図

【図3】同要部である凹版の製造工程を模式的に示す概略図

【図4】同要部である凹版表面の溝の形状を模式的に示す断面図

【図5】同要部である凹版への導体ペーストの充填工程を模式的に示す概略図

【図6】同要部であるラミネート工程を模式的に示す概略図

【図7】（a）同要部であるポリイミド凹版と絶縁基板とのラミネート状態を模式的に示す断面図

（b）従来のガラス凹版と絶縁基板とのラミネート状態を模式的に示す断面図

【図8】同要部である剥離工程を模式的に示す概略図

【図9】同要部である焼成工程の焼成温度条件を示す図

【図10】同要部であるビアホールの形状を模式的に示す断面図

【図11】（a）本発明の他の実施例におけるハイブリッドIC基板の模式的な平面図

（b）（a）の11B－11B′線における断面図

【図12】本発明によって製造される他のハイブリッドIC基板の模式的な断面図

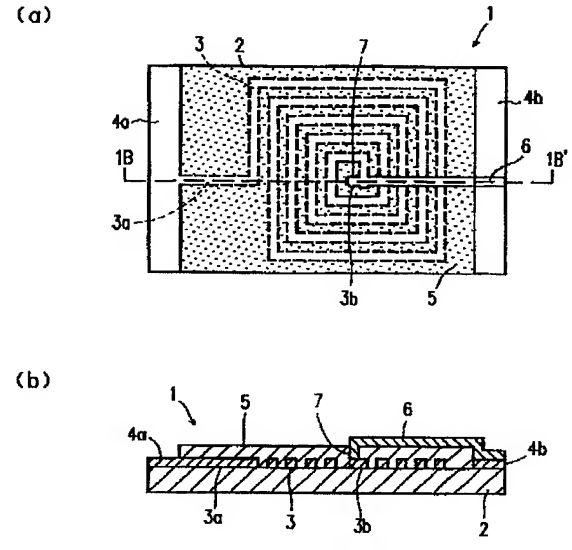
【図13】本発明によって製造されるさらに他のハイブリッドIC基板の模式的な断面図

【図14】本発明によって製造されるさらに他のハイブリッドIC基板の模式的な断面図

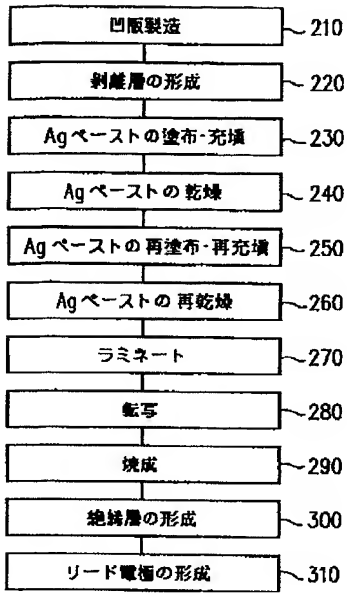
【符号の説明】

1　チップインダクタ
2　絶縁基板
3　コイル導体
4a，4b　端子電極
5　絶縁層
6　リード電極
7　ビアホール電極
11　エキシマレーザ装置
12　マスク
13　ミラー
14　イメージングレンズ
15　ポリイミドフィルム
16　XYステージ
20　ポリイミド凹版
21　溝
22　ピット
23　剥離層
24　Agペースト
25　スキージ
26，27　熱ローラ
28，28′　樹脂層（PVB層）
29　ガラス凹版
30，40，50　ハイブリッドIC基板
31　絶縁基板
32　下層導体パターン
33　絶縁層
34　上層導体パターン
35，35′　ビアホール電極
36　フェースダウン実装部
51，52，53　導体パターン
61　ICチップ

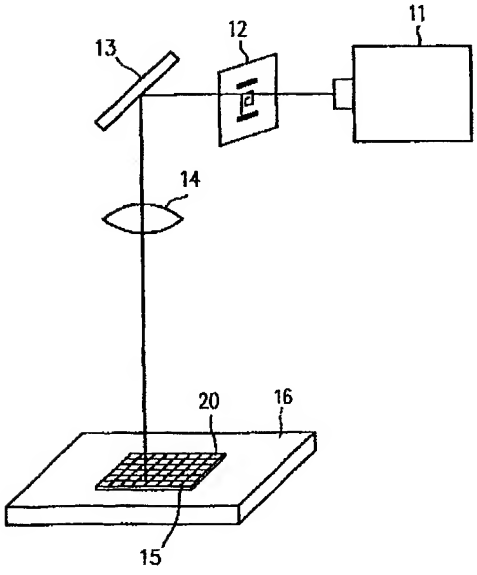
【図1】


(a)
1
3
2
7
4b
4a
6
1B
1B'
3a
3b
5
(b)
1
5
7
6
4a
4b
3a
3
3b
2

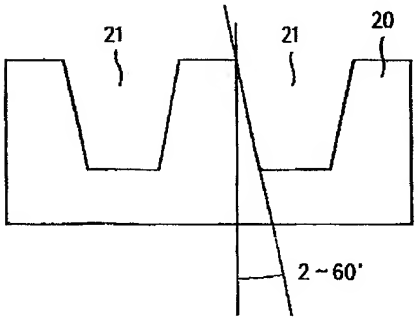
【図2】


凹版製造
210
剥離層の形成
220
Agペーストの塗布・充填
230
Agペーストの乾燥
240
Agペーストの再塗布・再充填
250
Agペーストの再乾燥
260
ラミネート
270
転写
280
焼成
290
絶縁層の形成
300
リード電極の形成
310

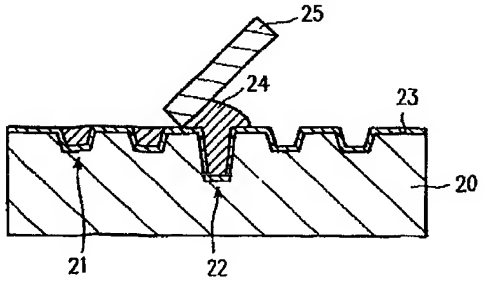
【図3】


11
12
13
14
20
16
15

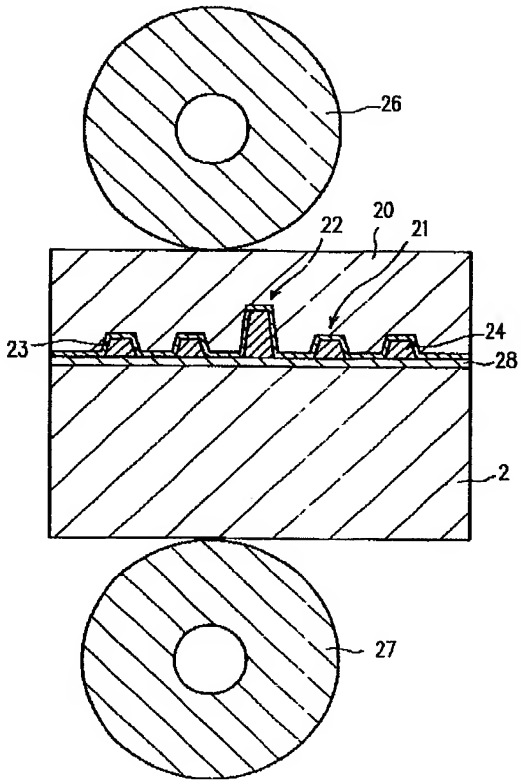
【図4】


21
21
20
2～60°

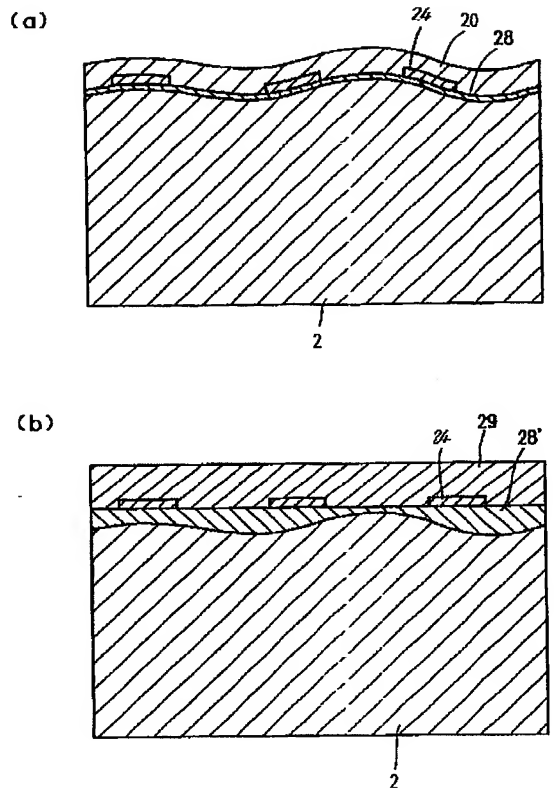
【図5】


25
24
23
20
21
22

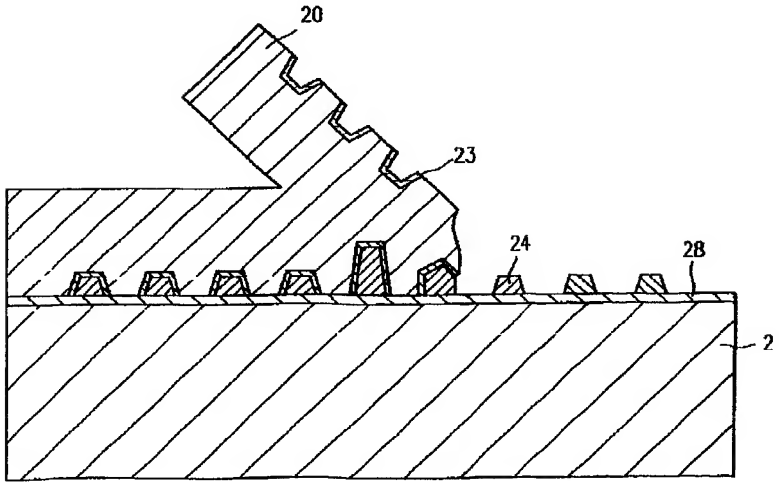
【図6】



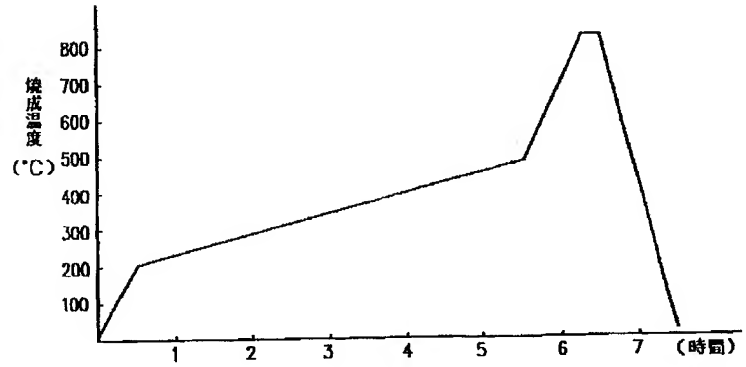
【図7】



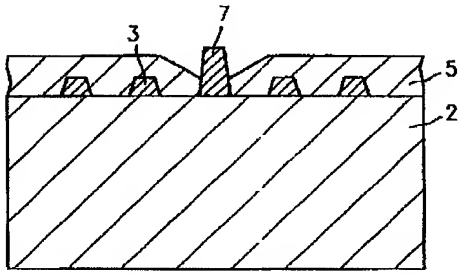
【図8】



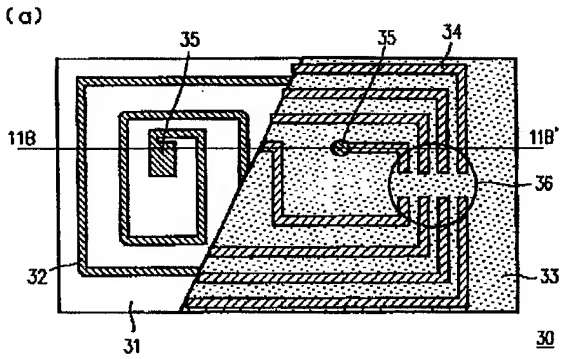
【図9】



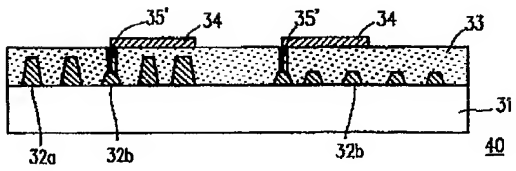
【図10】



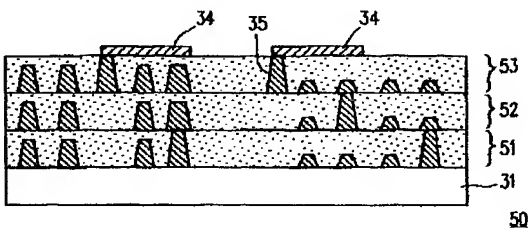
【図11】



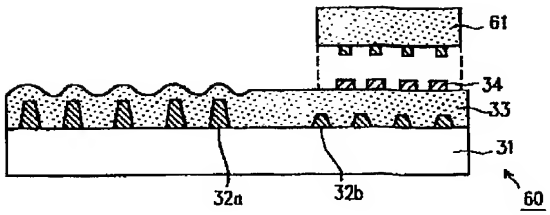
【図12】



【図13】



【図14】



DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] (a) The typical plan of the chip inductor in one example of this invention
The cross section in the 1B-1B' line of (b) and (a)
[Drawing 2] The block diagram showing the flow of the process of the manufacture method of these electronic parts
[Drawing 3] The schematic diagram showing typically the manufacturing process of intaglio printing which is this important section
[Drawing 4] The cross section showing typically the configuration of the slot on the front face of intaglio printing which is this important section
[Drawing 5] the conductor to intaglio printing which is this important section -- the schematic diagram showing the restoration process of a paste typically
[Drawing 6] The schematic diagram showing typically the lamination process which is this important section
[Drawing 7] (a) The cross section showing typically the lamination state of the polyimide intaglio printing and the insulating substrate which are this important section
(b) The cross section showing typically the lamination state of the conventional glass intaglio printing and an insulating substrate
[Drawing 8] The schematic diagram showing typically the ablation process which is this important section
[Drawing 9] Drawing showing the burning-temperature conditions of the baking process which is this important section
[Drawing 10] The cross section showing typically the configuration of the beer hall which is this important section
[Drawing 11] (a) The typical plan of the hybrid IC substrate in other examples of this invention
The cross section in the 11B-11B' line of (b) and (a)
[Drawing 12] The typical cross section of other hybrid IC substrates manufactured by this invention
[Drawing 13] The typical cross section of the hybrid IC substrate of further others manufactured by this invention
[Drawing 14] The typical cross section of the hybrid IC substrate of further others manufactured by this invention
[Description of Notations]
1 Chip Inductor
2 Insulating Substrate
3 Coil -- Conductor
4a, 4b Terminal electrode
5 Insulating Layer
6 Lead Electrode
7 Beer Hall Electrode
11 Excimer Laser Equipment
12 Mask
13 Mirror
14 Imaging Lens
15 Polyimide Film
16 X-Y Stage
20 Polyimide Intaglio Printing
21 Slot
22 Pit
23 Stratum Disjunctum
24 Ag Paste
25 Squeegee
26 27 Heat roller
28 28' Resin layer (PVB layer)
29 Glass Intaglio Printing
30, 40, 50 Hybrid IC substrate
31 Insulating Substrate
32 Lower Layer Conductor Pattern

33 Insulating Layer
34 The Upper Conductor Pattern
35 35' Beer hall electrode
36 Face Down Mounting Section
51, 52, 53 Conductor pattern
61 IC Chip

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the electronic parts especially manufactured by intaglio printing, and its manufacture method about the electronic parts used for various electronic equipment, and its manufacture method.
[0002]
[Description of the Prior Art] In recent years, the miniaturization of electronic equipment is progressing and the miniaturization of the electronic parts used within electronic equipment in connection with it is progressing. the conductor which constitutes a pattern from under such a situation also to the conductor pattern of electronic parts -- laminated-structure-ization for the increase in the thickness of the electric conduction film which constitutes the conductor pattern aiming at lowering detailed-izing of a line (a line is only called hereafter) and line resistance, and a further miniaturization is demanded
[0003] The conductor pattern of the conventional electronic parts printed the pattern of conductive pastes, such as a silver paste and a copper paste, on the formed object (substrate) by print processes, such as screen-stencil and intaglio printing, calcinated this and has been formed. For example, since it is filled up with an electric conduction paste (organic-metal ink) in intaglio printing corresponding to the conductor pattern which should be formed and the electric conduction paste is dried and stiffened as application of an intaglio-printing method as indicated by JP,4-240792,A, the printing method which forms a desired conductor pattern is learned by imprinting the pattern through a hardenability resin on the substrate which is a formed object.
[0004] Furthermore, in the hybrid IC circuit, the thermal head, or the transparent electrode, the method by which the width of face of each line in a conductor pattern and the interval of a line used thin film formation and etching from the bird clapper minutely may be used. By this method, on the substrate which is a formed object, the thin film of electrical conducting materials, such as gold, aluminum, and ITO, is formed by vacuum evaporationo or sputtering, the mask pattern corresponding to the desired conductor pattern is formed, etching which next used the etching reagent and the mask pattern is performed, the thin film of an electrical conducting material is **********ed, finally a photopolymer is removed, and a conductor pattern is formed with the photo lithography technology using the photopolymer.
[0005]
[Problem(s) to be Solved by the Invention] However, the above-mentioned conventional method has the following troubles.
[0006] The conventional screen-stencil can be performed with a comparatively cheap facility, and there are few required processes. However, it is difficult to form a detailed conductor pattern [as / whose width of face of the line of the conductor pattern which should be formed is 70 micrometers or less] by screen-stencil. Moreover, it is difficult to reduce a line pitch to 150 micrometers or less. Moreover, in screen-stencil, since a conductor pattern is printed uniformly, according to the demand on a design, the difference of elevation (difference of the height of a line) cannot be prepared into a pattern.
[0007] the conductor which has the thickness of 5 micrometers or more in the conventional intaglio printing although the width of face of a line is able to form an about [line pitch 100micrometer] detailed conductor pattern by about 50 micrometers -- forming a film -- being difficult -- a conductor -- a limitation is in reduction of resistance
[0008] On the other hand, in order to attain the densification of a request of electronic parts, just detailed-izing of the conductor pattern of each class is not sometimes enough, therefore formation of a laminated structure is needed. In such a laminated structure, many layers also lap and the sandwich structure of a lower layer conductor pattern, an insulating layer, and the upper conductor pattern is formed. In this case, although it is necessary to form the beer hall which connects the conductor pattern of a vertical layer, detailed-ization of these beer halls is also needed with detailed-izing of a conductor pattern. However, formation of a detailed beer hall which is the diameter of 100 micrometers or less by the conventional printing method also including the method currently indicated by above-mentioned JP,4-240792,A is difficult.
[0009] Furthermore, in order to obtain the positive electrical installation between the conductor patterns of a vertical layer, it is necessary to form in the interior of a beer hall the electrode (for a beer hall electrode to be called hereafter) which connects a vertical layer. However, it is difficult to form an electrode in the interior of the beer hall of such a size by the conventional method, though a detailed beer hall with a diameter of 100 micrometers or less is able to be formed.
[0010] Moreover, in the conventional intaglio printing, intaglio printing generally formed with rigid-body material, such as glass and a silicon wafer, is used. In this case, in the process which imprints a conductor pattern to formed lifters, such as a ceramic and a glass substrate, through a hardenability resin, even if it is going to exfoliate intaglio printing and the formed

object which have been pasted up, deformation of intaglio printing hardly arises. Consequently, intaglio printing and the formed object which have been pasted up in fields must be exfoliated, and the strong ablation force is needed.
[0011] In order to solve this point, a metal sheet may be used as intaglio printing and flexible nature may be obtained. However, such even case, processing (formation of a slot) of the pattern configuration of intaglio printing is performed by wet etching. since this etching turns into isotropic etching -- the width of face of a line -- receiving -- a conductor -- processing of the high intaglio printing configuration of the aspect ratio which is needed in order that a film may form a thick (that is, a line is high) conductor pattern [like] cannot be performed
[0012] Formation of the conductor pattern which used photo lithography technology on the other hand is effective, when the width of face of a line forms the pattern of small area by several micrometers or less, as semiconductor technology may be used and it is. However, in formation of the conductor pattern used with electronic parts, to form the pattern of a general comparatively big area is needed. In such a case, you have to perform a series of processes, such as the vacuum evaporationo of an electric conduction film, an application of a resist, exposure, development, etching, and resist removal, using large-sized equipment. Consequently, since the facility to be used is expensive, the manufacturing cost tends to increase.
[0013] It is made in order that this invention may solve the above-mentioned technical problem. the purpose (1) The line width of face of a conductor pattern is [the thickness of an electric conduction film] 5 micrometers or more in 10 micrometers or less. And a detailed conductor pattern which contains the beer hall electrode of a size of the same grade as line width of face The manufacture method of the electronic parts which can be formed by the low cost and high-reliability, (2) -- the demand on the design of a conductor pattern -- doubling -- the arbitrary parts in a pattern -- a conductor -- the manufacture method of electronic parts that membranous thickness can be changed from the value of other parts, and the difference of elevation can be prepared in a conductor pattern -- (3) -- the manufacture method of the electronic parts which can laminate the conductor pattern which has the above features, and (4) -- it is offering the electronic parts manufactured by the above methods
[0014]
[Means for Solving the Problem] The manufacture method of the electronic parts of this invention is the manufacture method of the electronic parts which form the 1st conductor pattern by intaglio printing on a substrate. (a) The process which forms a slot in the front face of a flexible resin by the pattern corresponding to this 1st conductor pattern, and manufactures intaglio printing, (b) The process which prepares the stratum disjunctum which makes easy ablation with this substrate and this intaglio printing in the front face of this intaglio printing, (c) The process which fills up this slot with a conductive paste, and the process which dries conductive (d) this paste, (e) The process which repeats the predetermined number of the process re-filled up with an additional electric conduction paste, and the processes which re-dry this electric conduction paste after re-restoration in order to re-soften this conductive paste dried at this process (d) and to compensate a part for the volume decrease by dryness, (f) The process which laminates this intaglio printing and this substrate by applying the pressure of the heat of the predetermined range, and the predetermined range, and is stuck, (g) This intaglio printing is exfoliated from this substrate, the process which imprints the pattern of this electric conduction paste on this substrate, and the process which calcinates the pattern of this electric conduction paste by which (h) imprint was carried out, and forms this 1st conductor pattern are included, and the above-mentioned purpose is attained by that.
[0015] In a certain example, a part of aforementioned slot formed in the aforementioned intaglio printing is formed at the aforementioned process (a) more deeply than other parts, and the difference of height is prepared in a part of 1st conductor pattern of the above by it.
[0016] In other examples, the process which forms a wrap insulating layer for a part of 1st conductor pattern [at least] of (i) above, the process which forms the 2nd conductor pattern in the front face of (j) this insulating layer, and the process which prepares the electrode which connects electrically this 1st conductor pattern and this 2nd conductor pattern to the portion which is not covered by this insulating layer of the (k) this 1st conductor pattern are included further.
[0017] In the example of further others, the process which forms a wrap insulating layer for a part of 1st conductor pattern [at least] of (l) above, and the process which forms the 2nd conductor pattern in the front face of (m) this insulating layer are included further, the part in which height is highly formed among this 1st conductor pattern is used as an electrode, and this 1st conductor pattern and this 2nd conductor pattern are connected electrically. You may form low the portion of the 1st conductor pattern of the above corresponding to the part which should prepare a flat part in the front face of the aforementioned insulating layer. Furthermore, you may include further the process which carries out face down mounting of the IC chip in the aforementioned flat part of the front face of the aforementioned insulating layer. Preferably, the aforementioned insulating layer is formed of the magnetic material.
[0018] In a certain example, the aforementioned slot is formed in the aforementioned process (a) using the laser which has the oscillation frequency of an ultraviolet region. Preferably, the aforementioned laser is an excimer laser.
[0019] In other examples, the aforementioned stratum disjunctum is the monomolecular film of a carbon fluoride system. In the example of further others, the plasticizer is added by the aforementioned conductive paste and it has flexibility.
[0020] In the example of further others, the aforementioned slot formed in the aforementioned intaglio printing has the cross-section configuration which has a taper angle on the side.
[0021] The aforementioned substrate is equipped with the aforementioned substrate and a resin layer with a thickness of 20 micrometers or less formed in one [at least] front face of this insulating substrate in the example of further others, and this resin layer is thermosetting resin or thermoplastics. Preferably, the aforementioned insulating substrate is formed from the dielectric material. Or the aforementioned insulating substrate is formed from the magnetic material.

[0022] In the example of further others, the aforementioned substrate is formed from the green sheet. The electronic parts of this invention are equipped with a substrate and the 1st conductor pattern imprinted on this substrate by intaglio printing which used intaglio printing formed by laser beam machining of a flexible resin, and the above-mentioned purpose is attained by that.
[0023] In a certain example, a part of 1st conductor pattern [at least] of the above is prepared in a wrap insulating layer, the 2nd conductor pattern formed in the front face of this insulating layer, and the part which is not covered by this insulating layer of this 1st conductor pattern, and it has further the electrode which connects electrically this 1st conductor pattern and this 2nd conductor pattern.
[0024] In other examples, the difference of height is prepared in a part of 1st conductor pattern of the above. In the example of further others, it has further the 2nd conductor pattern formed in the front face of a wrap insulating layer and this insulating layer in a part of 1st conductor pattern [at least] of the above, the part in which height is highly formed among this 1st conductor pattern is used as an electrode, and this 1st conductor pattern and this 2nd conductor pattern are connected electrically.
[0025] The portion of the 1st conductor pattern of the above corresponding to the part which should prepare a flat part in the front face of the aforementioned insulating layer may be formed low. Furthermore, you may equip further the aforementioned flat part of the front face of the aforementioned insulating layer with IC chip by which face down mounting was carried out.
[0026]
[Function] As mentioned above, in this invention, in manufacturing the electronic parts which have the conductor pattern (the 1st conductor pattern) formed on the substrate, the slot pattern corresponding to the conductor pattern which should be formed in the front face of the resin which has flexibility is formed, and intaglio printing is formed. And this intaglio printing is made to fill up with and dry an electric conduction paste. Furthermore, after repeating restoration / dryness process, a substrate and intaglio printing are laminated. And after exfoliating intaglio printing and imprinting the pattern of an electric conduction paste on a substrate, an electric conduction paste is calcinated and a desired conductor pattern is formed.
[0027] Moreover, a wrap insulating layer can be prepared for the 1st electric conduction pattern, and other conductor patterns (the 2nd conductor pattern) can also be formed in the front face. the electrode which connects both in connection of the conductor pattern of a vertical layer (the 1st and the 2nd) -- another process -- it can also prepare -- the [moreover,] -- the difference of height can be beforehand prepared in a part of 1 conductor pattern, and the portion formed highly can also be used as an electrode
[0028] Moreover, by forming low the 1st conductor pattern of the part corresponding to a place to use as a flat part especially on the front face of the aforementioned insulating layer, the influence height change of a conductor pattern affects the flatness on the front face of an insulating layer is mitigated, and flatness improves. Therefore, it becomes easy to carry out face down mounting of the IC chip at a part for this flat part.
[0029] In formation of the slot corresponding to the 1st conductor pattern, the laser beam oscillated in an ultraviolet wavelength field, for example, an excimer laser, can be used.
[0030] Moreover, ablation with intaglio printing and a substrate can be easily performed now by preparing the stratum disjunctum which consists of a monomolecular film of a carbon fluoride system in an intaglio printing front face.
[0031] Furthermore, it becomes possible by adding a plasticizer to a conductive paste to maintain the flexibility also after a dryness process.
[0032] By forming so that the side of the slot on the front face of intaglio printing may have a taper angle, the good imprint of the electric conduction paste with which the interior of a slot was filled up is performed.
[0033] The substrate which becomes a candidate for an imprint has an insulating substrate and the resin layer formed in the front face to a desirable bird clapper. The resin layer on the front face of an insulating substrate functions as a glue line at the time of the imprint of a conductor pattern. Moreover, a dielectric material, a magnetic material, etc. can be suitably used so that a desired property can be given to the electronic parts manufactured as a material of an insulating substrate. Furthermore, if a substrate is formed by the green sheet, formation of a resin layer on a front face is omissible.
[0034]
[Example] Below, the example of the manufacture method of the electronic parts of this invention is explained with reference to a drawing.
[0035] (Example 1) The manufacture method of the chip inductor 1 for RFs is taken for an example, and the 1st example of the manufacture method of the electronic parts of this invention is explained below with reference to drawing 1 -10. In addition, the same reference number is given to the same component with the following drawings.
[0036] The cross section of the chip inductor [in / the 1B-1B' line of drawing 1 (a) / drawing 1 (a), and / in drawing 1 (b)] 1 is shown, respectively. / the plan of the chip inductor 1 of this example
[0037] the spiral-like coil with which the chip inductor 1 was formed in the front face near the center section of the 2x1.25mm insulating substrate 2 -- it has a conductor (line) 3 and the terminal electrodes 4a and 4b formed in both the marginal parts of an insulating substrate 2 a coil -- outer edge 3a of a conductor 3 is connected to one terminal electrode 4a a coil -- while obtains inner edge 3b of a conductor 3 through the lead electrode 6 and the beer hall electrode 7, and it is connected to terminal electrode 4b this lead electrode 6 -- a coil -- after formation of a conductor 3 -- it -- a wrap -- it is further prepared in the maximum front face of the insulating layer 5 formed in the front face of an insulating substrate 2 like moreover, the coil which exists in the lead electrode 6 to which the beer hall electrode 7 exists in the maximum front face of an insulating layer 5, and the lowest side of an insulating layer 5 -- the conductor 3 is connected

[0038] The chip inductor 1 is manufactured by intaglio printing. Hereafter, the manufacture method is explained in order. Each processes 210-310 which appear in the following explanation are shown in the block diagram of drawing 2 .
[0039] First, with reference to drawing 3 , the manufacturing process 210 of the intaglio printing 20 used is explained. Intaglio printing 20 is formed on the polyimide film 15 with a thickness of 125 micrometers fixed on X-Y stage 16. A laser beam with a wavelength [of the ultraviolet region by which outgoing radiation was carried out from excimer laser equipment 11] of 248nm irradiates the mask 12 which has a mask pattern corresponding to the spiral pattern of the coil which should be formed, and the pattern of a terminal electrode. It is reflected by the mirror 13, it is reduced with the imaging lens 14, and the laser beam after mask 12 passage irradiates the polyimide film 15 top. The portion irradiated by the laser beam among the polyimide films 15 is decomposed by photochemical reaction, and the slot 21 (refer to drawing 4) equivalent to the line of a conductor pattern is formed. Of this, the intaglio printing 20 corresponding to the desired pattern is formed. Typically by repeating the above-mentioned irradiation operation, a total of 4000 intaglio printings 20 with a size of 2x1.25mm is formed on the 100mm 100mmx polyimide film 15, moving X-Y stage 16.
[0040] Processing by the excimer laser is photolysis processing by the laser beam of the ultraviolet wavelength field where peak power amounts to several ten MW to processing by the carbon dioxide laser or the YAG laser being pyrolysis processing by the laser beam of an infrared wavelength field. Moreover, since the pulse width of a laser beam is short, there is little thermal influence of the circumference on [other than a processing field]. Consequently, in processing by the excimer laser, the line width of face of a pattern can perform detailed processing of 10 micrometers or less.
[0041] Moreover, combination of the molecule which constitutes a film is cut and the front face of the polyimide film 15 of a portion with which the laser beam was irradiated is in the state where it was activated very much chemically. Therefore, a chemical bond tends to happen in the portion. This feature is advantageous to formation of the stratum disjunctum mentioned later.
[0042] Drawing 4 shows the typical cross-section configuration of the slot 21 of the intaglio printing 20 formed by the above-mentioned method. By adjusting appropriately the property of the optical system used at laser-beam-machining processes, such as the depth of focus of a lens, a slot 21 is formed so that it may have the cross-section configuration of the trapezoidal shape which has the taper angle the side of whose is 2-60 degrees. By this, the imprint to the formed lifter of the electric conduction paste filled up with a next process into the interior of a slot 21 can carry out now easily. In addition, typically, in the time of the outgoing radiation from excimer laser equipment 11, the configuration of the laser beam used is 8x24mm in rectangle, is at the irradiation time to the polyimide film 15, and is 3.2x9.6mm in rectangle.
[0043] Moreover, the processing side of intaglio printing 20 can be protected from an interaction with the plasma generated at the time of formation of a slot 21 by preparing the suitable protective layer for the processing front face of the polyimide film 15 which becomes the material of intaglio printing 20. This can protect deformation of opening of the slot 21 of the front face of intaglio printing 20. In addition, as a material of the protective layer of the above-mentioned purpose, a polyethylene terephthalate (PET), a polycarbonate (PC), and the poly ape phon (PSF) can be used, for example.
[0044] Next, a mask 12 is exchanged for the mask for formation of the beer hall electrode 7, a laser beam is irradiated further, and the pit 22 (refer to drawing 5) of the cylindrical shape equivalent to the beer hall electrode 7 is formed in the position of the slot 21 of the conductor pattern formed at the previous process. In formation of a pit 22, it can form so that micro processing may be possible like the time of formation of a slot 21, and, and a pit 22 may have a taper configuration. [the imprint of the electric conduction paste with which it filled up] In addition, it is also possible to form the pit 22 which has configurations other than a cylindrical shape.
[0045] The intaglio printing 20 corresponding to the conductor pattern which should be formed which includes the slot 21 with a depth [equivalent to a line with a width of face of 10 micrometers - 50 micrometers] of 20 micrometers and the pit 22 with a diameter [equivalent to a beer hall electrode with a diameter of 45 micrometers] of 60 micrometers by the above method is formed. By changing only the irradiation time of a laser beam, the depth of a slot 21 or a pit 22 can be arbitrarily changed per 0.2 micrometers, without changing the width of face (width of face of a slot 21) of a line, and can be made into the optimal value. Moreover, the width of face of a slot 21 and the diameter of a pit 22 can be easily adjusted by changing the size of a mask. It is also possible to set line width of face of a conductor pattern to 10 micrometers or less, or to make the size of a beer hall small by this, corresponding to such a detailed line according to the method of this invention.
[0046] In addition, according to this invention, flexibility (flexible nature) can be given to intaglio printing 20 by using the polyimide film 15 as a material of intaglio printing 20 as mentioned above. The effect acquired by that is mentioned later.
[0047] A conductor pattern is imprinted on the front face of a formed object using the intaglio printing 20 formed by the above-mentioned method. However, the polyimide film 15 currently used as a material of intaglio printing 20 is not enough as the detachability of the electric conduction paste and film 15 with which it fills up into a slot 21 and a pit 22 and which are imprinted. Therefore, in an imprint process, an electric conduction paste tends to remain inside a slot 21 and a pit 22. Especially in the pit 22 equivalent to the beer hall electrode 7, since the depth is deep, survival of an electric conduction paste occurs notably especially. Consequently, a result by which the configuration of intaglio printing 20 is not fully imprinted is brought. Therefore, in order to realize the imprint of a perfect intaglio printing configuration substantially, the formation process 220 of the stratum disjunctum in the front face of the front face of intaglio printing 20 especially a slot 21, and a pit 22 is required.
[0048] Artificers considered the ablation processing to the polyimide film 15 wholeheartedly from the ablation force especially over an electric conduction paste, and the point of the life of a processing layer, in order to solve the above-mentioned trouble. Consequently, it checked that it was effective to form the stratum disjunctum of a carbon fluoride

system monomolecular film by the following methods.
[0049] First, oxygen plasma is irradiated on the front face of intaglio printing 20 by O2 Usher, and density of the oxygen which exists in the front face of intaglio printing 20 is made [many]. The solution which melted the solvent 3 of non-aquosity with which the matter which contains a carbon fluoride machine and a chlorosilicane machine in a 80% [of n hexadecane] (or toluene, xylene, and dicyclohexyl are sufficient), 10% [of carbon tetrachlorides], and chloroform 8% mixed solution was mixed on the other hand, for example, CF3(CF2)7(CH2)2SiCl, by about 1% of concentration is prepared. Into this solution, the intaglio printing 20 by which oxygenation was carried out as mentioned above is immersed, and an oxide film is formed on the front face of intaglio printing 20. It reacts with the SiCl basis of the matter which many hydroxyl groups are contained in the front face of this oxide film, and contains a carbon fluoride machine and a chlorosilicane machine, and a dechlorination reaction arises. Consequently, the carbon fluoride system monomolecular film chemisorbed according to covalent bond is formed in the front face of intaglio printing 20 over the whole front face of intaglio printing 20. This monomolecular film functions effectively as stratum disjunctum 23 (refer to drawing 5).
[0050] The parts which need the big ablation force at the time of ablation are mainly the portions of a slot 21 and a pit 22, and, as for stratum disjunctum 23, mainly being formed in such a portion is desirable. On the other hand, as stated previously, the portion in which the slot 21 and the pit 22 were formed by processing by the excimer laser among the polyimide films 15 which constitute intaglio printing 20 is in an activity state chemically. As a result, it joins together more mostly and the stratum disjunctum 23 of the above-mentioned carbon fluoride system monomolecular film is formed in the interior of the slot 21 by which the big ablation force is needed at the time of ablation, and a pit 22. Moreover, since the combination with stratum disjunctum 23 and intaglio printing 20, i.e., the above-mentioned monomolecular film and the polyimide film 15, is covalent bond, it has joined together very powerfully and both have the endurance of the ablation effect. Furthermore, 100-1000A and since the thickness of stratum disjunctum 23 is thin, it cannot affect the configuration precision of intaglio printing 20, but can fill up the intaglio printing 20 interior with many electric conduction pastes.
[0051] Thus, the stratum disjunctum 23 formed in the front face of intaglio printing 20 at a process 220 has the property which was very excellent.
[0052] Next, the Ag paste 24 is applied to the front face of intaglio printing 20 on which stratum disjunctum 23 was formed in the front face as mentioned above as an electric conduction paste as a process 230. And while removing the Ag paste 24 with intaglio printing 20 excessive front face by scratching intaglio printing 20 front face after an application by the squeegee 25, it is fully filled up with the Ag paste 24 into a slot 21 and a pit 22 (refer to drawing 5).
[0053] Here, according to the examination about the quality of the material of the squeegee 25 which was performed by artificers and to be used, by this invention, it became clear for the following reasons that use of the squeegee 25 made from a ceramic is desirable. That is, the product made of a resin or the squeegee made from steel tends to get damaged with the dust which exists in the front face of the foreign matter contained during the Ag paste 24, or intaglio printing 20. Therefore, by the flaw on such a front face of a squeegee, intaglio printing 20 front face becomes easy to get damaged, and the life of intaglio printing 20 decreases. As for the squeegee 25 made from a ceramic, a stiff sake has few injuries on the point according to a foreign matter or dust to it. Furthermore, if the point of the squeegee 25 made from a ceramic is smoothed with the fine abrasives of more than No. 2000, exhaustion by prolonged wear can also be prevented. Consequently, the squeegee 25 made from a ceramic has damaging [little] the front face of intaglio printing 20.
[0054] Next, the intaglio printing 20 filled up with the Ag paste 24 is dried using a circulating hot air drying equipment, and the organic solvent under Ag paste 24 is evaporated (process 240). By this, the Ag paste 24 with which the slot 21 and pit 22 of intaglio printing 20 were filled up can be made to be able to fit with the configuration of a slot 21 and a pit 22, and a more sharp configuration can be acquired. In addition, a dryness means is not restricted above.
[0055] The trench 21 and the pit 22 are comparatively formed in the front face of the intaglio printing 20 currently treated by this example, and especially the pit 22 has the maximum depth as deep as 60 micrometers. Therefore, if intaglio printing 20 is quickly dried at the temperature of 100 degrees C or more in this dryness process 240, it will be easy to generate a pinhole with a diameter of 5-40 micrometers in the Ag paste 24 with which the interior of a slot 21 and a pit 22 is filled up. In a detailed conductor pattern [as / whose line width of face is 50 micrometers or less], such a pinhole becomes an open poor cause after pattern baking, and bars formation of a good conductor pattern.
[0056] Then, at the dryness process 240 of this invention, intaglio printing 20 is dried in two stages as follows. That is, dryness for 5 minutes is first performed predrying for 5 minutes and performed at the temperature of 150 degrees C continuously with the temperature of 100 degrees C or less. By it, generating of the above pinholes can be prevented and formation of a conductor pattern without open poor generating after baking is attained.
[0057] The effect of suppression of the same pinhole generating as the above can be acquired also by changing to operation of the above-mentioned predrying and performing the temperature up from a room temperature to 150 degrees C by the following ** and kana temperature gradients by 15-degree-C/.
[0058] In addition, the flexibility will be easy to be lost if the Ag paste 24 inside a slot 21 or a pit 22 is dried or stiffened at the above-mentioned process 240. Consequently, in imprinting the conductor pattern which has detailed line width of face (for example, 100 micrometers or less), a crack occurs in the Ag paste 24 by the stress generated at the time of an imprint, and a bird clapper is one of the open poor causes after baking. In order to prevent such un-arranging, in this invention, a 0.1 - 10wt% plasticizer is added during the Ag paste 24. By this, as it has flexibility moderate after the Ag paste's 24 drying, generating of the crack in an imprint process can be prevented. As a plasticizer, the plasticizer of a phthalic-ester system, for example, a dimethyl phthalate, a diethyl phthalate, or a dioctyl phthalate can be used.

[0059] If the above dryness processes 240 are performed, the volume of the Ag paste 24 with which the interior of a slot 21 or a pit 22 is filled up will decrease as equivalent to an evaporated part of the organic solvent. Then, in order to compensate this decrement, the restoration process and dryness process of the Ag paste 24 are repeated once again. When the organic solvent evaporates at the previous dryness process 240, the Ag paste 24 hardened at once is again softened in this re-restoration. While preparing the configuration of the Ag paste 24 with which it fills up to a still better thing according to this re-restoration process 250 and the re-dryness process 260, thickness of the Ag paste 24 can be made equivalent to the depth of the slot 21 of intaglio printing 20, and a pit 22.

[0060] When the Ag paste 24 remains into the portion between the non-pattern section of intaglio printing 20, especially each slot 21, it may become the cause that the short circuit between the lines of a conductor pattern is poor. Survival of such an Ag paste 24 is because it scratches, a ****** phenomenon occurs working and the Ag paste 24 remains into the portion by the squeegee 25 which should be removed, in order that the Ag paste 24 may have viscosity and may tend to pull thread. However, if re-restoration is performed in the re-restoration process 250 as mentioned above in the state where the Ag paste 24 of dryness exists in the interior of a slot 21 and a pit 22, the solvent of the Ag paste 24 newly applied to the non-pattern section will be absorbed by the paste of the dryness inside a slot 21 or a pit 22, and the viscosity of the Ag paste 24 which remained in the non-pattern section will increase. Consequently, when removing the Ag paste 24 of the non-pattern section by the squeegee, a ****** phenomenon does not occur, but the residual paste of this portion is removed easily. Therefore, the conductor pattern which the poor short circuit between lines does not produce can be formed.

[0061] In addition, it is also possible to repeat them twice or more at explanation of this example, if needed, although the re-restoration process 250 and the re-dryness process 260 are repeated by a unit of 1 time, respectively.

[0062] Next, the thermoplastics layer 28 is formed on an insulating substrate 2, and the formed object with which a conductor pattern is imprinted is obtained. This resin layer 28 functions as a glue line at the time of an imprint. And intaglio printing 20 front face and thermoplastics 28 of the side which has the slot 21 and pit 22 where it filled up with the Ag paste 24 are made to counter, and intaglio printing 20 and an insulating substrate 2 are laminated as typically shown in drawing 6 (process 270).

[0063] If the thickness of the thermoplastics layer 28 becomes extremely thick so that it may mention later, the combustion gas of resin layer 28 self will occur so much at the time of baking, and the trouble that a conductor pattern is not formed well will occur. It is checked as a result of examination by the artificer that 20 micrometers or less are suitable for the thickness of the resin layer 28.

[0064] As for the temperature of the lamination process 270, it is more desirable than the glass transition temperature of the resin layer 28 to be used to set up within the limits of 30-degree-C low temperature to temperature high 100 degrees C. If lamination temperature is higher than the above-mentioned upper limit, the fluidity of the resin layer 28 becomes large too much, with the pressure at the time of a lamination, the resin layer 28 will become thin and the imprint of the Ag paste 24 from the slot 21 and pit 22 of intaglio printing 20 will no longer be performed good. On the other hand, the fluidity of the resin layer 28 does not have lamination temperature more enough for a low case than the above-mentioned lower limit, the adhesion of the Ag paste 24 and the resin layer 28 becomes bad, and an imprint is not performed good too.

[0065] Furthermore, as for the pressure at the time of a lamination, it is desirable to set it as the range to the limiting-pressure-of-explosive-decomposition value which the crack of an insulating substrate 2 generates from 1 kg/cm2. When a pressure value is smaller than the above-mentioned lower limit and a wave is shown in the front face of an insulating substrate 2, between the intaglio printing 20 at the time of a lamination and insulating substrates 2 may not stick completely, but a foam may mix among both. Such a phenomenon may be too connected with a poor imprint.

[0066] In consideration of the above-mentioned examination result, the lamination process 270 is performed on condition that the following by this example.

[0067] First, the solution of butyl carbitol acetate which dissolved the polyvinyl butyral resin (it is hereafter written as PVB) which is thermoplastics is applied to the front face of the insulating substrate 2 made from the alumina of 100mm angle, and it dries. By this, the PVB layer 28 with a thickness of 10 micrometers is formed in the whole front face of an insulating substrate 2. Next, the insulating substrate 2 which formed the PVB layer 28 in this way, and the intaglio printing 20 filled up with the Ag paste 24 are laminated using the heat rollers 26 and 27 under the temperature of 100 degrees C, pressure 20 kg/cm2, and conditions with a speed of 5cm [/second], as shown in drawing 6 . In addition, what is necessary is just to apply the PVB layer 28 using the dipping method, the spinner method, or the coating method for using a roll coaster. Although the PVB layer 28 was formed only in one side of an insulating substrate 2 in this example, you may form in both sides.

[0068] Usually, as typically shown in drawing 7 (a) or drawing 7 (b), a wave with a maximum width of about 30 micrometers exists in the front face of an insulating substrate 2. Since the rigidity of the glass intaglio printing 29 is too strong as shown in drawing 7 (b) when using the glass intaglio printing 29 like before, intaglio printing 29 cannot fully follow the external waviness configuration of an insulating substrate 2. Therefore, you have to laminate by making thickness of PVB layer 28' uneven to about 10-50 micrometers, and absorbing a wave. For this reason, PVB layer 28' cannot be formed so that it may fall within the range (20 micrometers or less) of the desirable thickness described previously.

[0069] However, according to the composition which uses the intaglio printing 20 made of a resin which was rich in flexible nature like this invention, as shown in drawing 7 (a), intaglio printing 20 can fully follow the external waviness configuration of an insulating substrate 2. Therefore, regardless of the external waviness configuration of an insulating substrate 2, the PVB layer 28 with a thickness of 10 micrometers or less can be formed on an insulating substrate 2.

[0070] Next, after lowering the temperature of the intaglio printing 20 and the insulating substrate 2 which were laminated even to a room temperature as an imprint process 280, intaglio printing 20 is made to exfoliate from an insulating substrate 2,

and the Ag paste 24 patternized according to the conductor pattern is imprinted.
[0071] Since intaglio printing 20 is rich in flexible nature with the composition of this invention at this time, it is possible to bend intaglio printing 20 in angle of 90 degrees or more, as shown in drawing 8 . Consequently, ablation of the intaglio printing 20 from an insulating substrate 2 turns into ablation with a field and a line. For this reason, the required ablation force is reduced and intaglio printing 20 can be exfoliated easily. Since intaglio printing 29 cannot be bent to an angle as shown in drawing 8 but it becomes ablation with a field and a field on the other hand in using the glass intaglio printing 29 (refer to drawing 7 (b)) with the strong conventional rigidity, the big ablation force is required. Moreover, if angle of bend of intaglio printing 29 is enlarged too much, a crack will occur easily in intaglio printing 29 or an insulating substrate 2. Therefore, great cautions were required for both ablation, and workability had produced the increase in work cost or working hours well.
[0072] According to this invention, even if it uses the intaglio printing 20 which has a pattern with a width of face [of a slot / of 15 micrometers], and a depth of 20 micrometers, for example, there is no survival of the Ag paste 24 inside a slot 21, and the same width of face and the depth of a slot 21, and the conductor pattern that has the same height substantially can be substantially imprinted and formed with the width of face of the above-mentioned slot 21. Moreover, about beer hall electrode section, the diameter of the pit 22 of intaglio printing 20 can imprint and form the conductor pattern of the size to which it is completely equivalent substantially like the case of a slot 21 when the depth is 60 micrometers by 45 micrometers. moreover, a conductor -- since a line and a beer hall electrode are simultaneously formed in one at the same process, the electrical installation between both is secured certainly
[0073] Furthermore, in the electronic parts used in a high-frequency field like the chip inductor 1 for RFs of this example, in order to make a skin resistance small and to raise an electric operating characteristic, it is necessary to make the shape of surface type of a conductor pattern as sharp as possible. However, since wet etching used for formation of the conventional copper plate or glass intaglio printing turns into isotropic etching, high processing of an aspect ratio cannot be performed. It becomes impossible therefore, to form a trench as the line width of face which a pattern should become detailed and should be formed becomes thin. Moreover, the edge section of a slot will be roundish, without becoming sharp. If intaglio printing 20 is processed with an excimer laser like this invention to it, the pattern which has a keen edge can be formed. Furthermore, since the Ag paste 24 does not remain inside a slot 21 or a pit 22 at the time of an imprint as already explained, the pattern which has the configuration of the keen intaglio printing 20 and the same sharp configuration is imprinted. therefore, the conductor pattern formed according to this example -- the object for RFs -- it has the property which was excellent as a conductor
[0074] Next, the process 290 which calcinates the insulating substrate 2 by which the conductor pattern was imprinted as mentioned above under a temperature pattern with a peak temperature [as shown in drawing 9] of 850 degrees C is performed. Since the insulating substrate 2 set as the object of baking by this invention becomes the structure where the conductor pattern is formed through the PVB layer (resin layer) 28, depending on a setup of baking conditions, combustion gas may occur from the PVB layer 28, and the ablation and deformation which lead to the defect of a conductor pattern may arise. It is desirable to carry out the temperature gradient at the time of the temperature up between 200 degrees C - 500 degrees C equivalent to temperature in order to prevent such inconvenient generating, after combustion of the PVB layer 28 is started until it ends in 200 degrees C /or less in an hour.
[0075] Although already explained a little in relation to explanation of the lamination process 270, the relation between the thickness of the PVB layer 28 in the case of carrying out the baking process 290 on such conditions and the performance of the formed conductor pattern is shown in (Table 1).
[0076]
[Table 1]

PVB膜厚	焼成後パターン形状	焼成後パターンはがれ
10μm	○	○
20μm	○	○
30μm	×	△
50μm	×	×
100μm	×	×

評価基準

アルミナ基板100mm角内（2×1.25mmサイズ400個）中

○ − − − 95％以上良品

△ − − − 70％以上良品

× − − − 良品70％以下

[0077] From (Table 1), if the thickness of the PVB layer 28 is 20 micrometers or less, a desired conductor pattern can be calcinated, without degradation and ablation of a configuration arising. However, when the thickness of the PVB layer 28 is set to 30 micrometers or more, it turns out that the defect of shape of a pattern and ablation occur at the time of baking. Therefore, the thickness of the PVB layer 28 has the thinner advantageous one in property. The polyimide intaglio printing 20 of this invention which can store the thickness of the PVB layer 28 within the limits of [desirable] the above can form the conductor pattern which was excellent in quality by the polyimide intaglio printing 20 of this invention previously compared with reference to drawing 7 (a) and drawing 7 (b) from this, and the conventional glass intaglio printing 29.

[0078] Moreover, according to the method of the above this inventions, the line 3 and the beer hall electrode 7 in a conductor pattern are simultaneously formed in one. The positive electrical installation between a line 3 and the beer hall electrode 7 is obtained by this.

[0079] Next, in order to form an insulating layer 5, the pattern of a glass paste is printed and formed in the front face of the insulating substrate 2 which formed the conductor pattern by the Ag paste 24 in the front face at the above process (process 300). At this time, the screen version of 150 micrometers of diameters of a mask is used for the portion of the beer hall electrode 7, and it prints it by glass ceramics with a viscosity of 200,000cps. From this, "bleeding" of printing occurs into the portion of the beer hall electrode 7, and the thickness of a wrap glass paste becomes thinner than other portions about the circumference of the beer hall electrode 7. Consequently, a beer hall configuration is formed in the circumference of the beer hall electrode 7.

[0080] Since the path of the beer hall formed is prescribed by the configuration of a beer hall electrode, even if formation is the very small beer hall which is the difficult diameter of about 40 micrometers, according to this invention, printing formation can be carried out easily until now. Moreover, since a beer hall very small in this way can be formed, only the part can make the number of turns of a spiral-like coil pattern increase. The inductance value acquired can be enlarged by this.

[0081] The pattern of the glass paste printed as mentioned above is held for 10 minutes in peak temperature of 820 degrees C, and is calcinated to it, and an insulating layer 5 is formed. Since glass ceramics are used at this time, there is few flow under baking and the printed pattern configuration is kept good.

[0082] By the conventional method, in order to connect the vertical layer conductor pattern of a multilayer-structure substrate mutually, opening was prepared in the insulating layer by patterning or etching by screen-stencil etc., it considered as the beer hall, the electrode material was embedded further there, and the beer hall electrode was formed. However, by this method, the faulty connection between the lower layer conductor patterns by therefore the electrical installation of the upper layer or/, and a lower layer conductor pattern and a beer hall electrode not being enough and the upper conductor patterns in the embedding process of an electrode might occur badly. However, by the method by this invention, since formation of the beer hall electrode 7 is simultaneously performed in one with formation of a lower layer conductor pattern as already stated, the above faulty connections are not generated.

[0083] Furthermore, since the configuration and thickness of the beer hall electrode 7 can be set up arbitrarily, connection between the upper conductor pattern and the beer hall electrode 7 can be ensured by making the beer hall electrode 7 into a configuration which is made to project several micrometers from the front face of an insulating layer 5. Moreover, even if it is the detailed beer hall electrode 7 dimensionally by making the cross-section configuration of a direction perpendicular to substrate 2 front face of the beer hall electrode 7 into a trapezoidal shape, only the connection resilience needed at a back

process has structure fully acquired.
[0084] Finally, the process 310 which forms the lead electrode 6 on an insulating layer 5 is performed. This is formed by screen-stenciling the pattern of the lead electrode 6 on insulating-layer 5 front face with Ag paste, and calcinating by holding for 10 minutes in peak temperature of 810 degrees C. The chip inductor 1 of this example is manufactured by this.
[0085] Although the above-mentioned explanation has explained the manufacture method of the electronic parts of this example taking the case of the chip inductor 1, as for necessarily not being restricted to the chip inductor 1, it is needless to say that it can manufacture. For example, according to this invention, the electrode section of other electronic parts, such as a chip bead, an EMI filter, and a capacitor, or other electronic parts which have a laminated structure can be manufactured.
[0086] Moreover, by the above-mentioned explanation, after imprinting and forming a conductor pattern according to processes 210-290, formation of an insulating layer 5 and the lead electrode 6 is performed at processes 300 and 310. Or when such structure forms an unnecessary conductor pattern, if even processes 210-290 are performed, a desired conductor pattern is obtained and it is not necessary to perform processes 300 and 310.
[0087] Moreover, although Ag paste was used as a material of the electric conduction paste used in order to form a conductor pattern, it is not limited to this. For example, other metal paste or resinate pastes, such as Cu, nickel, aluminum, and Au, can be used. Moreover, the electric conduction paste containing the resin which has flexible nature suitable after hardening by the ultraviolet-rays hardenability resin or thermosetting resin besides the electric conduction paste containing the organic solvent can also be used.
[0088] If it has moderate flexibility (flexible nature) as a material of intaglio printing 20, resin sheets other than the above-mentioned polyimide film 15, such as PET, PSF, PC, PEI (polyether imide), PAR (polyacrylate), and PEEK (polyether ketone), can be used. Moreover, thermoplastics, or epoxy and the acrylic thermosetting resin of an ethyl-cellulose system can be used for the material of the resin layer 28 formed on an insulating substrate 2.
[0089] Furthermore, although the equipment stuck thermally was used in the lamination process of intaglio printing 20 and an insulating substrate 2 in the above explanation, putting a pressure using the heat rollers 26 and 27, you may use the press equipment which equipped at least one side with the hot platen.
[0090] The material of the insulating substrate 2 which constitutes the formed object for imprinting and forming a conductor pattern is not restricted to a specific thing, and material currently generally used, such as a ceramic, can be used for it. Or you may be the dielectric which makes a barium titanate a subject.
[0091] When forming inductance parts especially, it is desirable to form either [at least] an insulating substrate 2 or the insulating layer 5 with magnetic-substance material, such as a ferrite. This is because the inductance value of the electronic parts formed can be improved with the permeability of such magnetic-substance material.
[0092] Or a formed object can be formed by the green sheet. Since the green sheet has the property softened by heating, when forming a formed object using a green sheet, in a process 270, formation of the resin layer 28 which functions as a glue line at the time of an imprint can be omitted.
[0093] Although excimer laser equipment 11 was used for formation of intaglio printing 20, if wavelength can emit the laser beam of an ultraviolet-rays field, other sources of laser, such as dye laser and a free electron laser, can be used. Furthermore, if it is the light source which can emit the beam which has the energy density of required level equivalent to such laser in the above-mentioned wavelength field, it is also possible to use other things other than the source of laser.
[0094] (Example 2) The manufacture method of a hybrid IC (it is hereafter written as HIC) substrate of having the laminated structure of a conductor pattern for the 2nd example of the manufacture method of the electronic parts of this invention is taken for an example, and it explains with reference to drawing 11 - drawing 14 . In addition, the same reference mark is attached to the same component in drawing 11 - drawing 14 .
[0095] It is the cutting plane of the HIC substrate [in / the 11B-11B' line of drawing 11 (a) / drawing 11 (a), and / in drawing 11 (b)] 30. / the plan of the HIC substrate 30 In addition, as for the right half of drawing 11 (a), the conductor pattern of a lower layer [left half / the portion and left half / in which the upper conductor pattern is formed] shows the portion currently formed. Moreover, since drawing 11 (a) and drawing 11 (b) are simplified and show the composition of the HIC substrate 30 typically, the conductor pattern in a drawing is not reflecting correctly the value of the size described below.
[0096] The HIC substrate 30 has the two-layer wiring structure which consists of an insulating layer 33 formed so that the lower layer conductor pattern 32 and the lower layer conductor pattern 32 which were formed on the insulating substrate 31 might be covered, and the upper conductor pattern 34 formed on the insulating layer 33. the lower layer conductor pattern 32 is understood from drawing 11 (b) -- as -- a spiral-like coil -- a conductor -- section 32a and the other conductor -- section 32b is included The lower layer conductor pattern 32 and the upper conductor pattern 34 are connected by the beer hall electrode 35. Moreover, the mounting section 36 for carrying out face down mounting of the IC chip is formed in a part of upper conductor pattern 34.
[0097] the inside of the lower layer conductor pattern 32 -- a coil -- a conductor -- a conductor pattern with a height (namely, a conductor membranous thickness) of 35 micrometers is formed in the portion equivalent to section 32a from a viewpoint of an electrical property, for example by pitch 60micrometer (namely, width of face of 30 micrometers of each line, the interval of 30 micrometers of a line) Moreover, the beer hall electrode 35 is formed in a height (namely, a conductor membranous thickness) of 50 micrometers so that a nose of cam may jump out of the front face of an insulating layer 33 and between the conductor patterns 32 and 34 of a vertical layer may be connected certainly. On the other hand, the face down mounting section 36 of the upper conductor pattern 34 is formed for example, by pitch 150micrometer (namely, width of face of 75 micrometers of each line, the interval of 75 micrometers of a line).

[0098] Furthermore, flatness [as / whose wave per length of 5mm of restrictions of the mounting conditions at the time of carrying out face down mounting of the IC chip to a front face is 3 micrometers or less] is required for this face down mounting section 36. in this case, the conductor located under the face down mounting section 36 among the lower layer conductor patterns 32 -- if there are 5 micrometers or more of height of section 32b (conductor membranous thickness), the wave of the front face of an insulating layer 33 will become large, and face down mounting will become difficult therefore, a conductor -- the height of section 32b is stopped by 5 micrometers or less

[0099] as mentioned above, the conductor of places arbitrary among the conductor patterns formed in the 2nd example of this invention -- it changes into the level of a request of membranous thickness (height of a line), and the conductor pattern which has the difference of elevation is formed in a pattern Of this, the HIC substrate 30 which enabled face down mounting of IC chip to the position of the upper conductor pattern 34 on the front face of the maximum is formed.

[0100] Below, the manufacture method of the HIC substrate 30 of this example is explained. In addition, each processes, such as manufacture of intaglio printing in the following explanation, are substantially [as each process corresponding to the 1st example] equivalent only by the configurations of the conductor pattern which is a candidate for formation differing. Therefore, the detailed explanation about the feature etc. is omitted.

[0101] first, intaglio printing for forming the lower layer conductor pattern 32 -- the process 210 of the 1st example -- the same -- the coil of the lower layer conductor pattern 32 -- a conductor -- the conductor of the object for section 32a creation, and others -- a total of three kinds of masks for beer hall electrode 35 creation are used for the object for section 32b creation, and a row, and it forms in following sequence on a polyimide film using an excimer laser first, a coil -- a conductor -- the coil which consists of a slot with a depth of 45 micrometers using the mask corresponding to the pattern of section 32a -- a conductor -- the pattern equivalent to section 32a is formed Next, the pattern equivalent to the beer hall electrode which consists of a slot with a depth of 65 micrometers is formed using the mask corresponding to the pattern of the beer hall electrode 35. the last -- a conductor -- the conductor which consists of a slot with a depth of 10 micrometers using the mask corresponding to the pattern of section 32b -- the pattern equivalent to section 32b is formed By carrying out alignment of the relative position of each pattern formed at each above-mentioned process in the precision of less than 5 micrometers, intaglio printing for forming the lower layer conductor pattern 32 is formed.

[0102] Thus, on formed intaglio printing, the stratum disjunctum which consists of a carbon fluoride system monomolecular film like the process 220 of the 1st example is formed. Next, each slot on the intaglio printing is filled up with Ag paste like the process 230 of the 1st example using the squeegee made from a ceramic. After that, like a process 240, the organic solvent which dries Ag paste with the formula dryer of the circulating-heat style, and is contained inside is evaporated, and only the volume integral equivalent to evaporation decreases the paste inside the slot on the intaglio printing. Furthermore, like processes 250 and 260, after being re-filled up with Ag paste, two stages are dried. Thus, thickness of the film of Ag paste can be substantially made equal with each depth of flute by repeating restoration and the dryness process of a paste as well as the 1st example.

[0103] Next, like a process 270, a thermoplastics layer with a thickness of 10 micrometers is formed in insulating-substrate 31 front face, and intaglio printing and an insulating substrate 31 are stuck at pressure 25 kg/cm2 and the substrate temperature of 130 degrees C. Then, like a process 280, substrate temperature is lowered to a room temperature, intaglio printing is exfoliated, and a conductor pattern is imprinted on an insulating substrate 31. Furthermore, the temperature up of the insulating substrate 31 which imprinted the conductor pattern is carried out by the 200 degrees C [/hour] temperature gradient to the peak temperature of 850 degrees C like a process 290, and baking processing is performed.

[0104] Of a series of above processes, the lower layer conductor pattern 32 and the beer hall electrode 35 are simultaneously formed in one like the case of the 1st example.

[0105] Next, the pattern of an insulating layer 33 is formed on an insulating substrate 31 by screen-stencil of a glass paste like a process 300. And it calcinates at the temperature of 840 degrees C, and an insulating layer 33 is formed. At this time, by using glass ceramics like the 1st example, there is few flow of the glass paste under baking, and the configuration formed by screen-stencil is kept comparatively good.

[0106] Next, the pattern which is equivalent to the upper conductor pattern 34 after formation of an insulating layer 33 is formed by screen-stencil of Ag paste. And the upper conductor pattern 34 is formed by baking processing held for 10 minutes in peak temperature of 810 degrees C.

[0107] above -- carrying out -- the inside of a conductor pattern -- a spiral-like coil -- a conductor -- the coil which was excellent in the same electrical property as the 1st example enlarging the height (conductor membranous thickness) of the line of the portion equivalent to 32a is formed Moreover, electrical installation of the upper conductor pattern 34 and the lower layer conductor pattern 32 can be certainly performed by making the cross section in a direction perpendicular to the substrate front face of the beer hall electrode 35 into a trapezoidal shape. Moreover, flattening of the front face of an insulating layer 33 can realize flattening of the request in a required part by making thin alternatively thickness of the lower layer conductor pattern 32 in arbitrary predetermined parts. The HIC substrate 30 in which face down mounting of IC chip is possible is manufactured by this.

[0108] The configuration of the beer hall electrode 35 is not restricted to the configuration shown in drawing 11 (b). For example, electrode 35' of a configuration which fills a part of beer hall can also be formed like the HIC substrate 40 shown in drawing 12 . Or a beer hall is prepared at the time of formation of an insulating layer 33, and as the lower layer conductor pattern 32 is not completely covered by the insulating layer, it may prepare the electrode which connects the lower layer conductor pattern 32 and the upper conductor pattern 34 in a beer hall at a process other than the formation process of the

lower layer conductor pattern 32.
[0109] Furthermore, although the above-mentioned explanation explained taking the case of the two-layer wiring substrate, it is also possible to achieve multilayering further. For example, in the HIC substrate 50 shown in drawing 13 , the three-layer laminating of the conductor patterns 51, 52, and 53 by which each is equivalent to much more pattern of the HIC substrates 30 and 40 shown in drawing 11 (b) or drawing 12 is carried out on the insulating substrate 31.
[0110] Furthermore, according to this example, since the difference of elevation can be prepared in the line of a conductor pattern, the HIC substrate 60 which has the shape of surface type of an insulating layer 33 as shown in drawing 14 can also be formed. the HIC substrate 60 -- the wave of the front face of the insulating layer 33 among lower layer conductor patterns -- the conductor by which control of a configuration is equivalent to an unnecessary portion -- section 32a is formed by the comparatively high line (a thick conductor film) the conductor equivalent to the portion which, on the other hand, needs to make the front face of an insulating layer 33 flat like the portion which carries out face down mounting of the IC chip 61 -- section 32b is comparatively formed by the low line (a thin conductor film) a conductor -- if the height of section 32b becomes low -- a conductor -- although resistance increases -- the need -- responding -- a conductor -- the bad influence to an electrical property can be pressed down by enlarging width of face of the line of section 32b
[0111] Thus, according to this invention, the optimal configuration of a conductor pattern can be acquired in consideration of the trade-off with the demand to the shape of surface type of an insulating layer 33, and the demand to the electrical property of a conductor pattern.
[0112] As mentioned above, according to the manufacture method of the electronic parts of this invention, the slot pattern corresponding to the conductor pattern which should be formed in the front face of the resin sheet which was rich in flexible nature is formed by irradiation of an excimer laser, and intaglio printing is manufactured. The electric conduction paste with which the slot pattern of intaglio printing is filled up is substantially imprinted completely on the substrate which is a formed object. Moreover, since the configuration of the slot formed in intaglio printing can be made sharp, the configuration of the conductor pattern formed of baking after an imprint also turns into the desired shape of a sharp rectangle. The electrical property of the conductor pattern formed is improved by this.
[0113] the field of size -- the width of face of the line of a conductor pattern -- 10 micrometers or less -- it is -- a conductor -- as [be / 5 micrometers or more / membranous thickness] -- formation of the conductor pattern of detailed and a thick film is possible moreover -- arbitrary predetermined parts -- a conductor -- membranous thickness can be thickened, namely, the line of a conductor pattern can be made high According to the manufacture method of the electronic parts of this invention, by applying these points, formation of the beer hall where width of face is very small is substantially [as the size of a detailed conductor pattern] possible to an equivalent grade. Therefore, by the conventional printing method, realization can manufacture the electronic parts which have the difficult small laminated structure by the low cost.
[0114] in addition -- explanation of the 1st [more than] and the 2nd example -- the inside of a conductor pattern -- a conductor -- the electronic parts of the type for which to create a membranous thick portion is needed were taken for the example, and this invention has been explained however, the other electronic parts -- namely, -- especially -- a conductor -- it is clear that the manufacture method of the electronic parts of this invention is applicable also to electronic parts which do not need to change membranous thickness partially or to thicken it It becomes an improvement means effective enough that ablation at an imprint process can carry out easily and certainly by use of intaglio printing formed from the flexible resin sheet even if it is such a case, and that the pattern of the shape of a sharp rectangle can be formed by the pattern formation on intaglio printing by the excimer laser for the property of the electronic parts manufactured.
[0115]
[Effect of the Invention] The imprint of the ablation and the conductor pattern of intaglio printing is performed without causing generating of the crack in an injury and conductor pattern of a substrate, or a pinhole by using intaglio printing which consists of a resin which was rich in flexibility according to this invention, as explained above. Moreover, since intaglio printing can follow and deform into the external waviness configuration even if a wave is shown in a substrate front face, a substrate and intaglio printing stick and the imprint of an electric conduction paste is performed good. moreover -- since an electric conduction paste can be imprinted completely -- the line width of face in a conductor pattern -- thin -- and a conductor -- even if it is a pattern with membranous thick thickness, it forms in a good configuration Furthermore, even if the volume of an electric conduction paste decreases by dryness by performing restoration and dryness of the electric conduction paste to intaglio printing two or more times, it becomes possible to make the configuration of the electric conduction paste with which it fills up fit with the configuration of a slot. Moreover, a conductor pattern can be imprinted also on an opaque substrate by performing a lamination with intaglio printing and a substrate thermally.
[0116] Furthermore, multilayer-structure-ization of a conductor pattern is also realized easily. Moreover, since it is possible to control easily the thickness of the electric conduction film of the arbitrary parts of a conductor pattern, optimization of an electrical property, the configuration on the front face of an insulating layer, etc. can be attained. For example, the portion highly formed in the conductor pattern can be used as an electrode which connects each conductor pattern of multilayer structure. Since a conductor pattern and an electrode are simultaneously formed in one of this, generating of defects, such as a faulty connection between both, is prevented by it. Or the flatness on the front face of an insulating layer corresponding to the portion improves by forming a conductor pattern low. By this, a flat part required for face down mounting of IC chip can be obtained.
[0117] A detailed pattern is formed easily and with high precision on intaglio printing in formation of the slot on the front face of intaglio printing the laser which has the oscillation frequency of an ultraviolet wavelength field, and by carrying out

with an excimer laser preferably. Moreover, a change of the depth of flute is easily made by change of the irradiation time of laser. Furthermore, since the configuration of the slot formed in intaglio printing can be made sharp, the configuration of the conductor pattern formed of baking after an imprint also turns into the desired shape of a sharp rectangle. The electrical property of the conductor pattern formed is improved by this.

[0118] The stratum disjunctum of a carbon fluoride system monomolecular film is easily formed on the surface of intaglio printing. Since it has combined with the intaglio printing front face according to covalent bond, this stratum disjunctum is durable, and the result maintains it. Moreover, since it is a monomolecular layer, stratum disjunctum is thin and does not affect the configuration of intaglio printing.

[0119] a conductor -- by adding a plasticizer to a paste and giving flexibility to it, it becomes possible to follow, even if intaglio printing is crooked flexibly Furthermore, since it can have moderate flexibility even if it is after a dryness process, the stress at the time of an imprint can fully be opposed, and generating of the defect in an electric conduction paste is prevented.

[0120] By giving a taper to intaglio printing, it becomes possible to make still easier ablation and an imprint of the electric conduction paste with which it filled up, and the conductor pattern of a good configuration is formed.

[0121] Although the resin layer can be used as a glue line at the time of an electric conduction paste pattern imprint when using the insulating substrate which prepared the resin layer in the front face as a substrate, generating of the defect of the conductor pattern under the influence of the combustion gas which occurs from the resin layer itself at the time of a thermal lamination is suppressed by setting especially resin layer thickness to 20 micrometers or less. If a dielectric material and a magnetic material are used as an insulating material, it will become possible to give a desired property to the electronic parts formed. Moreover, if a substrate is formed by the green sheet, it will become possible to omit formation of the resin layer which can use the property which a green sheet softens and functions as a glue line with the heat applied at the time of a lamination.

[0122] Furthermore, in the electronic parts formed of this invention, while a highly precise and detailed conductor pattern is formed easily, multilayer-structure-ization is also performed easily. Moreover, the electrode which connects between the conductor patterns of each class can be put in block with a conductor pattern, and can be formed, and positive electrical installation can be obtained.

[Translation done.]

CLAIMS

[Claim(s)]

[Claim 1] In the manufacture method of the electronic parts which form the 1st conductor pattern by intaglio printing on a substrate (a) The process which forms a slot in the front face of a flexible resin by the pattern corresponding to the 1st conductor pattern of the above, and manufactures intaglio printing, (b) The process which prepares the stratum disjunctum which makes easy ablation with the aforementioned substrate and the aforementioned intaglio printing in the front face of the aforementioned intaglio printing, (c) The process which fills up the aforementioned slot with a conductive paste, and the process which dries the (d) aforementioned conductivity paste, (e) The process which repeats the predetermined number of the process re-filled up with an additional electric conduction paste, and the processes which re-dry the aforementioned electric conduction paste after re-restoration in order to re-soften the aforementioned conductive paste dried at the process (d) which dries the aforementioned conductive paste and to compensate a part for the volume decrease by dryness, (f) The process which laminates the aforementioned intaglio printing and the aforementioned substrate by applying the pressure of the heat of the predetermined range, and the predetermined range, and is stuck, (g) The manufacture method of the electronic parts which consist of a process which exfoliates the aforementioned intaglio printing from the aforementioned substrate, and imprints the pattern of the aforementioned electric conduction paste on the aforementioned substrate, and a process which calcinates the pattern of the aforementioned electric conduction paste by which (h) imprint was carried out, and forms the 1st conductor pattern of the above.

[Claim 2] The process (a) which forms a slot in the front face of a flexible resin by the pattern corresponding to the 1st conductor pattern of the above, and manufactures intaglio printing is the manufacture method of electronic parts according to claim 1 of forming more deeply than other parts a part of aforementioned slot formed in the aforementioned intaglio printing, and preparing the difference of height in a part of 1st conductor pattern of the above by it.

[Claim 3] The manufacture method of the electronic parts which form the 1st conductor pattern by intaglio printing on a substrate characterized by providing the following. (a) The process which forms a slot in the front face of a flexible resin by the pattern corresponding to the 1st conductor pattern of the above, and manufactures intaglio printing. (b) The process which prepares the stratum disjunctum which makes easy ablation with the aforementioned substrate and the aforementioned intaglio printing in the front face of the aforementioned intaglio printing, (c) The process which fills up the aforementioned slot with a conductive paste, and the process which dries the (d) aforementioned conductivity paste, (e) The process which repeats the predetermined number of the process re-filled up with an additional electric conduction paste, and the processes which re-dry the aforementioned electric conduction paste after re-restoration in order to re-soften the aforementioned conductive paste dried at the process (d) which dries the aforementioned conductive paste and to compensate a part for the volume decrease by dryness, (f) The process which laminates the aforementioned intaglio printing and the aforementioned substrate by applying the pressure of the heat of the predetermined range, and the predetermined range, and is stuck, (g) The process which exfoliates the aforementioned intaglio printing from the aforementioned substrate, and imprints the pattern of the aforementioned electric conduction paste on the aforementioned substrate, (h) The process which calcinates the pattern of the imprinted aforementioned electric conduction paste, and forms the 1st conductor pattern of the above, (i) The process which forms a wrap insulating layer for a part of 1st conductor pattern [at least] of the above, (j) The process which forms the 2nd conductor pattern in the front face of the aforementioned insulating layer, and process which prepares the electrode which connects electrically the 1st conductor pattern of the above, and the 2nd conductor pattern of the above to the portion which is not covered by the aforementioned insulating layer of the 1st conductor pattern of (k) above.

[Claim 4] (l) The manufacture method of the electronic parts according to claim 2 which include further the process which forms a wrap insulating layer for a part of 1st conductor pattern [at least], and the process which forms the 2nd conductor pattern in the front face of the (m) aforementioned insulating layer, use as an electrode the part in which height is highly formed among the 1st conductor pattern of the above, and connect electrically the 1st conductor pattern of the above, and the 2nd conductor pattern of the above.

[Claim 5] The manufacture method of the electronic parts according to claim 4 which form low the portion of the 1st conductor pattern of the above corresponding to the part in which a flat part should be prepared on the surface of an insulating layer.

[Claim 6] The manufacture method of the electronic parts according to claim 5 which include further the process which carries out face down mounting of the IC chip in the aforementioned flat part of the front face of an insulating layer.

[Claim 7] The manufacture method of electronic parts given in either of the claims 3-6 in which the insulating layer is formed

of the magnetic material.
[Claim 8] The process (a) which forms a slot in the front face of a flexible resin by the pattern corresponding to the 1st conductor pattern of the above, and manufactures intaglio printing is the manufacture method of electronic parts given in either of the claims 1-7 which form the aforementioned slot using the laser which has the oscillation frequency of an ultraviolet region.
[Claim 9] The manufacture method of electronic parts according to claim 8 that laser is an excimer laser.
[Claim 10] The manufacture method of electronic parts given in either of the claims 1-9 whose stratum disjunctum is the monomolecular films of a carbon fluoride system.
[Claim 11] The manufacture method of electronic parts given in either of the claims 1-10 which the plasticizer is added by the conductive paste and have flexibility.
[Claim 12] The manufacture method of electronic parts given in either of the claims 1-11 in which the aforementioned slot formed in intaglio printing has the cross-section configuration which has a taper angle on the side.
[Claim 13] It is the manufacture method of electronic parts given in either of the claims 1-12 whose aforementioned resin layers a substrate is equipped with an insulating substrate and a resin layer with a thickness of 20 micrometers or less formed in one [at least] front face of the aforementioned insulating substrate, and are thermosetting resin or thermoplastics.
[Claim 14] The manufacture method of electronic parts according to claim 13 that the insulating substrate is formed from the dielectric material.
[Claim 15] The manufacture method of electronic parts according to claim 13 that the insulating substrate is formed from the magnetic material.
[Claim 16] The manufacture method of electronic parts given in either of the claims 1-12 in which the substrate is formed from the green sheet.
[Claim 17] Electronic parts equipped with a substrate and the 1st conductor pattern imprinted on the aforementioned substrate by intaglio printing which used intaglio printing formed by laser beam machining of a flexible resin.
[Claim 18] Electronic parts characterized by providing the following. Substrate. It is a wrap insulating layer in a part of 1st conductor pattern imprinted on the aforementioned substrate by intaglio printing which used intaglio printing formed by laser beam machining of a flexible resin, and 1st conductor pattern [at least] of the above. The 2nd conductor pattern formed in the front face of the aforementioned insulating layer. The electrode which is prepared in the part which is not covered by the aforementioned insulating layer of the 1st conductor pattern of the above, and connects electrically the 1st conductor pattern of the above, and the 2nd conductor pattern of the above.
[Claim 19] Electronic parts according to claim 17 with which the difference of height is prepared in a part of 1st conductor pattern.
[Claim 20] Electronic parts according to claim 19 which are further equipped with the 2nd conductor pattern formed in the front face of a wrap insulating layer and the aforementioned insulating layer in a part of 1st conductor pattern [at least], use as an electrode the part in which height is highly formed among the 1st conductor pattern of the above, and connect electrically the 1st conductor pattern of the above, and the 2nd conductor pattern of the above.
[Claim 21] The manufacture method of electronic parts according to claim 20 that the portion of the 1st conductor pattern of the above corresponding to the part in which a flat part should be prepared on the surface of an insulating layer is formed low.

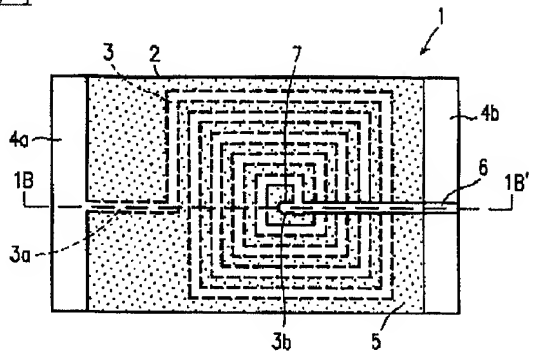
[Claim 22] Electronic parts according to claim 21 which equip further the aforementioned flat part of the front face of an insulating layer with IC chip by which face down mounting was carried out.

[Translation done.]

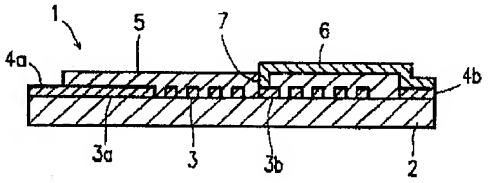
DRAWINGS

[Drawing 1]

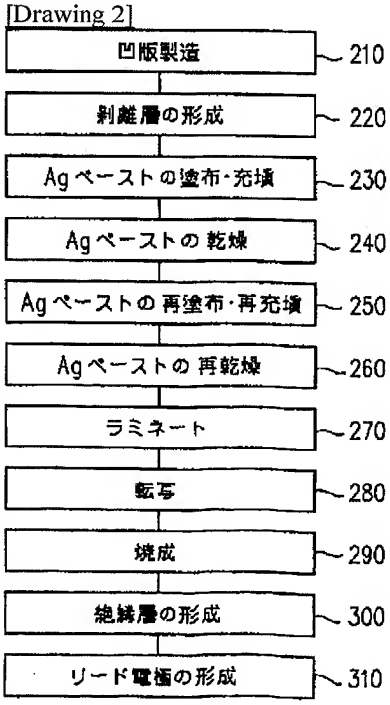
(a)



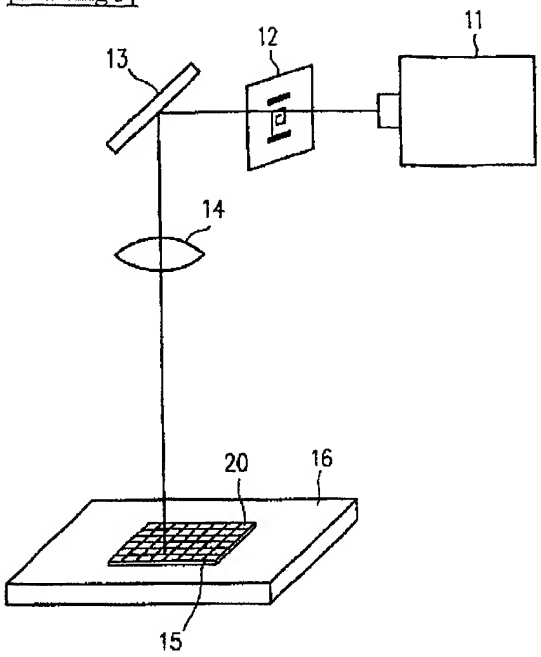
(b)



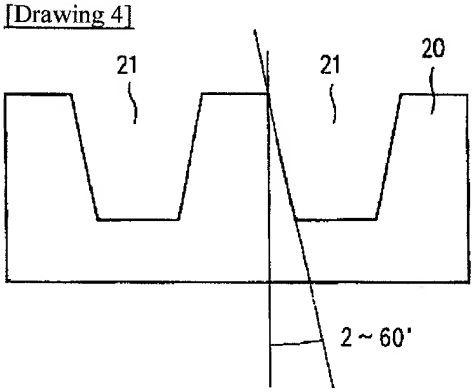
[Drawing 2]



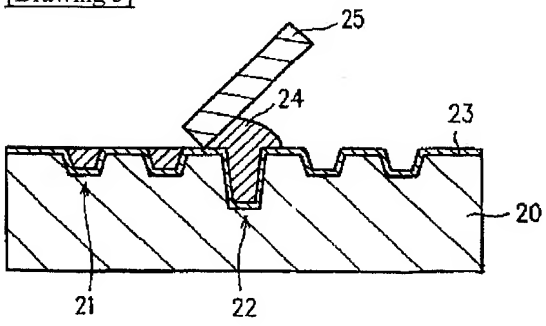
[Drawing 3]



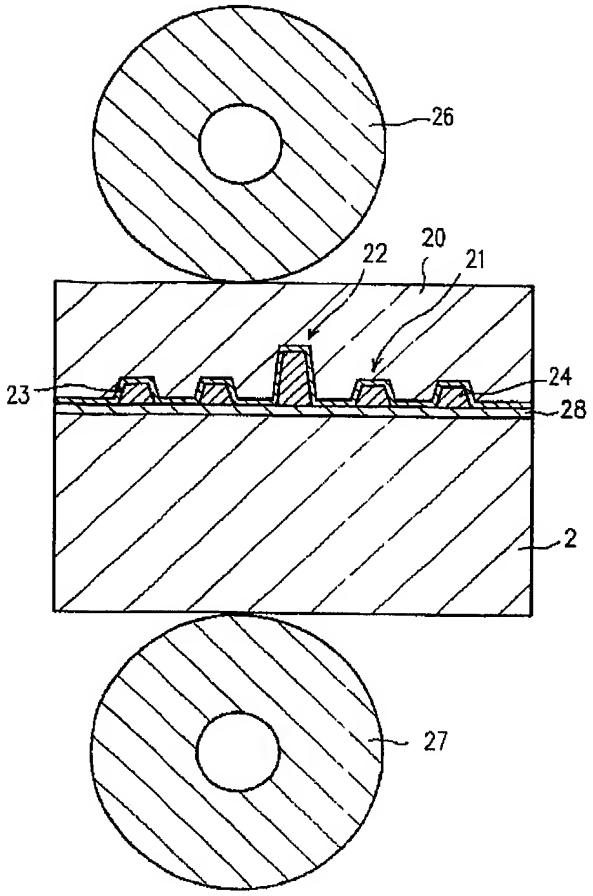
[Drawing 4]



[Drawing 5]

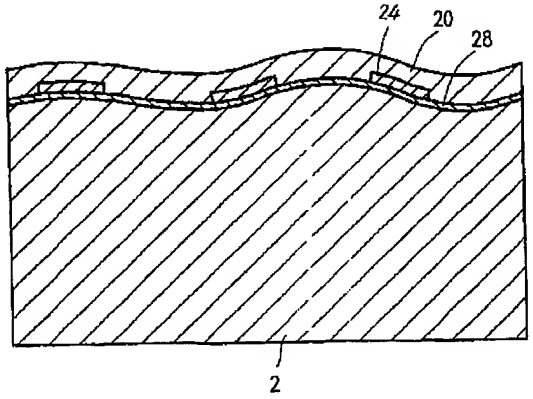


[Drawing 6]

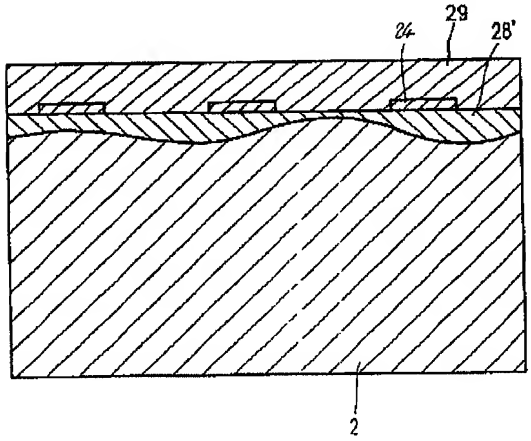


[Drawing 7]

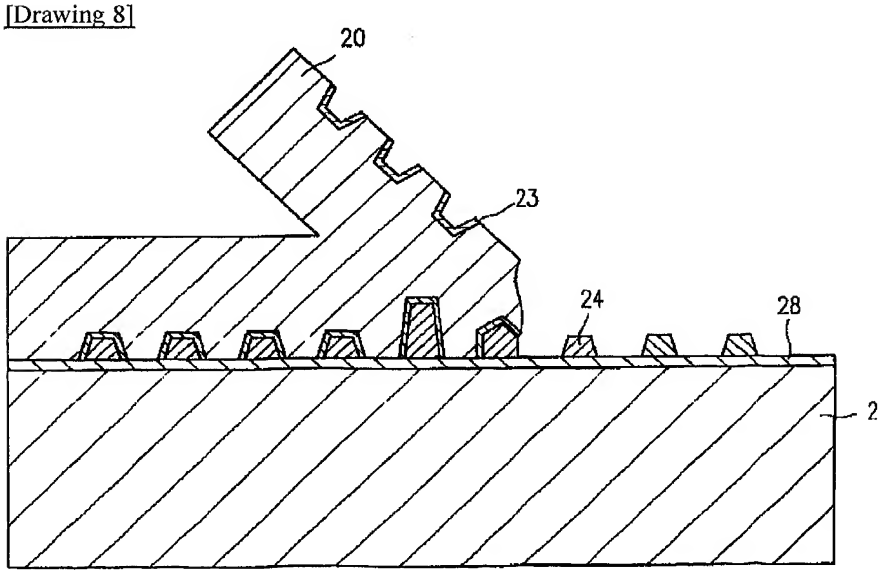
(a)



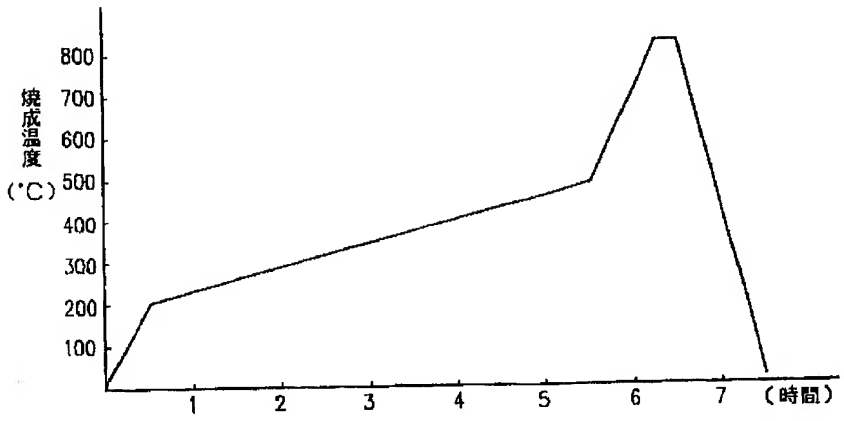
(b)



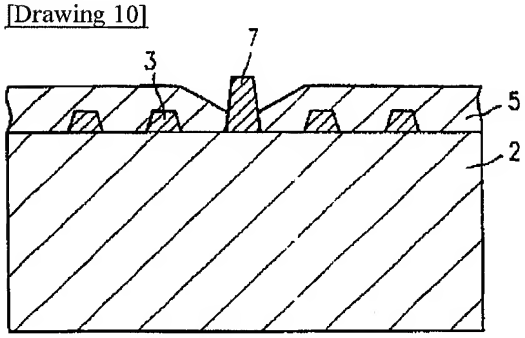
[Drawing 8]



[Drawing 9]

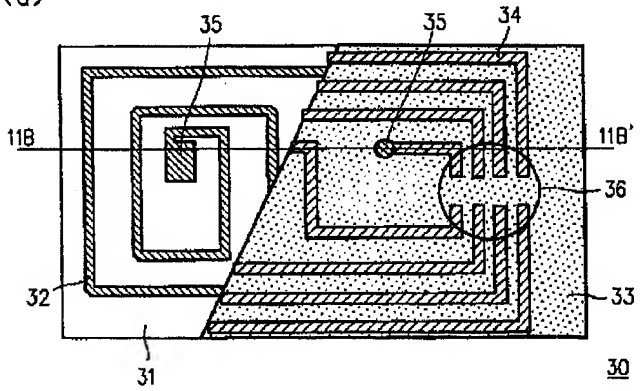


[Drawing 10]

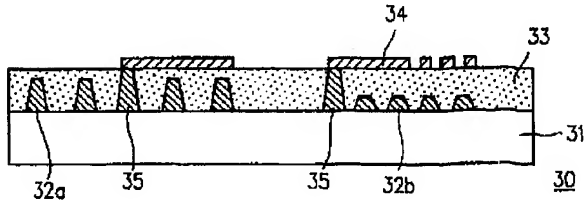


[Drawing 11]

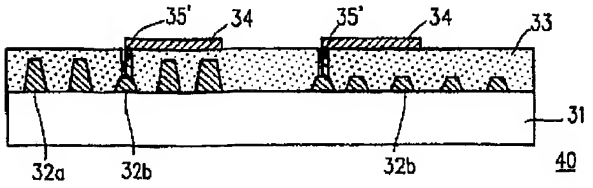
(a)



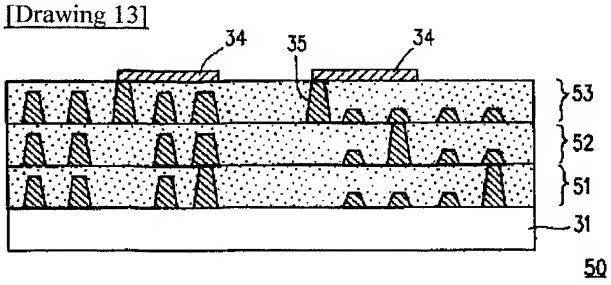
(b)



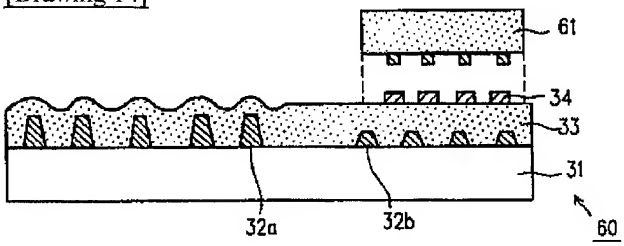
[Drawing 12]



[Drawing 13]



[Drawing 14]



[Translation done.]

* NOTICES *

CORRECTION or AMENDMENT

[Official Gazette Type] Printing of the amendment by the convention of 2 of Article 17 of patent law.
[Section partition] The 2nd partition of the 7th section.
[Date of issue] September 17, Heisei 11 (1999).

[Publication No.] Publication number 7-169635.
[Date of Publication] July 4, Heisei 7 (1995).
[**** format] Open patent official report 7-1697.
[Filing Number] Japanese Patent Application No. 6-226584.
[International Patent Classification (6th Edition)]

H01F 41/04
17/00

[FI]

H01F 41/04 B
17/00 B

[Procedure revision]
[Filing Date] September 29, Heisei 10.
[Procedure amendment 1]
[Document to be Amended] Specification.
[Item(s) to be Amended] Claim.
[Method of Amendment] Change.
[Proposed Amendment]
[Claim(s)]
[Claim 1] In the manufacture method of the electronic parts which form the 1st conductor pattern by intaglio printing on a substrate
(a) The process which forms a slot in the front face of a flexible resin by the pattern corresponding to the 1st conductor pattern of the above, and manufactures intaglio printing,
(b) The process which prepares the stratum disjunctum which makes easy exfoliation with the aforementioned substrate and the aforementioned intaglio printing in the front face of the aforementioned intaglio printing,
(c) The process which fills up the aforementioned slot with a conductive paste,
(d) The process which dries the aforementioned conductive paste,
(e) The process which repeats the predetermined number of the process re-filled up with an additional electric conduction paste, and the processes which re-dry the aforementioned electric conduction paste after re-restoration in order to compensate a part for the volume decrease by dryness of the aforementioned conductive paste dried at the process (d) which dries the aforementioned conductive paste,
(f) The process which laminates the aforementioned intaglio printing and the aforementioned substrate by applying the pressure of the heat of the predetermined range, and the predetermined range, and is stuck,
(g) The process which exfoliates the aforementioned intaglio printing from the aforementioned substrate, and imprints the pattern of the aforementioned electric conduction paste on the aforementioned substrate,
(h) The manufacture method of the electronic parts which consist of a process which calcinates the pattern of the imprinted aforementioned electric conduction paste, and forms the 1st conductor pattern of the above.
[Claim 2] The process (a) which forms a slot in the front face of a flexible resin by the pattern corresponding to the 1st conductor pattern of the above, and manufactures intaglio printing is the manufacture method of electronic parts according to claim 1 of forming more deeply than other parts a part of aforementioned slot formed in the aforementioned intaglio printing, and preparing the difference of height in a part of 1st conductor pattern of the above by it.
[Claim 3] In the manufacture method of the electronic parts which form the 1st conductor pattern by intaglio printing on a

substrate
(a) The process which forms a slot in the front face of a flexible resin by the pattern corresponding to the 1st conductor pattern of the above, and manufactures intaglio printing,
(b) The process which prepares the stratum disjunctum which makes easy exfoliation with the aforementioned substrate and the aforementioned intaglio printing in the front face of the aforementioned intaglio printing,
(c) The process which fills up the aforementioned slot with a conductive paste,
(d) The process which dries the aforementioned conductive paste,
(e) The process which repeats the predetermined number of the process re-filled up with an additional electric conduction paste, and the processes which re-dry the aforementioned electric-conduction paste after re-restoration in order to re-soften the aforementioned conductive paste dried at the process (d) which dries the aforementioned conductive paste and to compensate a part for the volume decrease by dryness,
(f) The process which laminates the aforementioned intaglio printing and the aforementioned substrate by applying the pressure of the heat of the predetermined range, and the predetermined range, and is stuck,
(g) The process which exfoliates the aforementioned intaglio printing from the aforementioned substrate, and imprints the pattern of the aforementioned electric conduction paste on the aforementioned substrate,
(h) The process which calcinates the pattern of the imprinted aforementioned electric conduction paste, and forms the 1st conductor pattern of the above,
(i) Process which forms a wrap insulating layer for a part of 1st conductor pattern [at least] of the above,
(j) The process which forms the 2nd conductor pattern in the front face of the aforementioned insulating layer,
(k) the process which prepares the electrode which connects electrically the 1st conductor pattern of the above, and the 2nd conductor pattern of the above to the portion which is not covered by the aforementioned insulating layer of the 1st conductor pattern of the above -- a shell -- the manufacture method of electronic parts according to claim 2
[Claim 4] (l) The process which forms a wrap insulating layer for a part of 1st conductor pattern [at least],
(m) The manufacture method of the electronic parts according to claim 2 which include further the process which forms the 2nd conductor pattern in the front face of the aforementioned insulating layer, use as an electrode the part in which height is highly formed among the 1st conductor pattern of the above, and connect electrically the 1st conductor pattern of the above, and the 2nd conductor pattern of the above.
[Claim 5] The manufacture method of the electronic parts according to claim 4 which form low the portion of the 1st conductor pattern of the above corresponding to the part in which a flat part should be prepared on the surface of an insulating layer.
[Claim 6] The manufacture method of the electronic parts according to claim 5 which include further the process which carries out face down mounting of the IC chip in the aforementioned flat part of the front face of an insulating layer.
[Claim 7] The manufacture method of electronic parts given in either of the claims 3-6 in which the insulating layer is formed of the magnetic material.
[Claim 8] The process (a) which forms a slot in the front face of a flexible resin by the pattern corresponding to the 1st conductor pattern of the above, and manufactures intaglio printing is the manufacture method of electronic parts given in either of the claims 1-7 which form the aforementioned slot using the laser which has the oscillation frequency of an ultraviolet region.
[Claim 9] The manufacture method of electronic parts according to claim 8 that laser is an excimer laser.
[Claim 10] The manufacture method of electronic parts given in either of the claims 1-9 whose stratum disjunctum is the monomolecular films of a carbon fluoride system.
[Claim 11] The manufacture method of electronic parts given in either of the claims 1-10 which the plasticizer is added by the conductive paste and have flexibility.
[Claim 12] The manufacture method of electronic parts given in either of the claims 1-11 in which the aforementioned slot formed in intaglio printing has the cross-section configuration which has a taper angle on the side.
[Claim 13] It is the manufacture method of electronic parts given in either of the claims 1-12 whose aforementioned resin layers a substrate is equipped with an insulating substrate and a resin layer with a thickness of 20 micrometers or less formed in one [at least] front face of the aforementioned insulating substrate, and are thermosetting resin or thermoplastics.
[Claim 14] The manufacture method of electronic parts according to claim 13 that the insulating substrate is formed from the dielectric material.
[Claim 15] The manufacture method of electronic parts according to claim 13 that the insulating substrate is formed from the magnetic material.
[Claim 16] The manufacture method of electronic parts given in either of the claims 1-12 in which the substrate is formed from the green sheet.
[Claim 17] Substrate,
Electronic parts equipped with the 1st conductor pattern imprinted on the aforementioned substrate by intaglio printing which used intaglio printing formed by laser beam machining of a flexible resin.
[Claim 18] Substrate,
It is a wrap insulating layer in a part of 1st conductor pattern imprinted on the aforementioned substrate by intaglio printing which used intaglio printing formed by laser beam machining of a flexible resin, and 1st conductor pattern [at least] of the above.

The 2nd conductor pattern formed in the front face of the aforementioned insulating layer,
Electronic parts which consist of an electrode which is prepared in the part which is not covered by the aforementioned insulating layer of the 1st conductor pattern of the above, and connects electrically the 1st conductor pattern of the above, and the 2nd conductor pattern of the above.
[Claim 19] Electronic parts according to claim 17 with which the difference of height is prepared in a part of 1st conductor pattern.
[Claim 20] It is a wrap insulating layer in a part of 1st conductor pattern [at least].
Electronic parts according to claim 19 which are further equipped with the 2nd conductor pattern formed in the front face of the aforementioned insulating layer, use as an electrode the part in which height is highly formed among the 1st conductor pattern of the above, and connect electrically the 1st conductor pattern of the above, and the 2nd conductor pattern of the above.
[Claim 21] The manufacture method of electronic parts according to claim 20 that the portion of the 1st conductor pattern of the above corresponding to the part in which a flat part should be prepared on the surface of an insulating layer is formed low.

[Claim 22] Electronic parts according to claim 21 which equip further the aforementioned flat part of the front face of an insulating layer with IC chip by which face down mounting was carried out.
[Procedure amendment 2]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0058.
[Method of Amendment] Change.
[Proposed Amendment]
[0058] In addition, the flexibility will be easy to be lost if the Ag paste 24 inside a slot 21 or a pit 22 is dried at the above-mentioned process 240. Consequently, in imprinting the conductor pattern which has detailed line width of face (for example, 100 micrometers or less), a crack occurs in the Ag paste 24 by the stress generated at the time of an imprint, and a bird clapper is one of the open poor causes after baking. In order to prevent such un-arranging, in this invention, a 0.1 - 10wt% plasticizer is added during the Ag paste 24. By this, as it has flexibility moderate after the Ag paste's 24 drying, generating of the crack in an imprint process can be prevented. As a plasticizer, the plasticizer of a phthalic-ester system, for example, a dimethyl phthalate, a diethyl phthalate, or a dioctyl phthalate can be used.
[Procedure amendment 3]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0059.
[Method of Amendment] Change.
[Proposed Amendment]
[0059] If the above dryness processes 240 are performed, the volume of the Ag paste 24 with which the interior of a slot 21 or a pit 22 is filled up will decrease as equivalent to an evaporated part of the organic solvent. Then, in order to compensate this decrement, the restoration process and dryness process of the Ag paste 24 are repeated once again. While preparing the configuration of the Ag paste 24 with which it fills up to a still better thing according to this re-restoration process 250 and the re-dryness process 260, thickness of the Ag paste 24 can be made equivalent to the depth of the slot 21 of intaglio printing 20, and a pit 22.
[Procedure amendment 4]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0060.
[Method of Amendment] Change.
[Proposed Amendment]
[0060] When the Ag paste 24 remains into the portion between the non-pattern section of intaglio printing 20, especially each slot 21, it may become the cause that the short circuit between the lines of a conductor pattern is poor. Survival of such an Ag paste 24 is because the unnecessary paste by the squeegee 25 writes, a ****** phenomenon occurs in inside and the Ag paste 24 remains into the portion which should be removed, in order that the Ag paste 24 may have viscosity and may tend to pull thread. However, if re-restoration is performed in the re-restoration process 250 as mentioned above in the state where the Ag paste 24 of dryness exists in the interior of a slot 21 and a pit 22, the solvent of the Ag paste 24 newly applied to the non-pattern section will be absorbed by the paste of the dryness inside a slot 21 or a pit 22, and the viscosity of the Ag paste 24 which remained in the non-pattern section will increase. Consequently, when removing the Ag paste 24 of the non-pattern section by the squeegee, a ****** phenomenon does not occur, but the residual paste of this portion is removed easily. Therefore, the conductor pattern which the poor short circuit between lines does not produce can be formed.

[Translation done.]